RAILROAD GAZETTE

SATURDAY, APRIL 1, 1871.

IMPROVED "GRADUATOR" OR REVERSE LEVER.

The object of this invention is to regulate more accurately the admission of steam to the cylinders. It frequently happens with an ordinary train, that it is necessary on reaching an incline or curve to increase slightly the period of steam admission; but at the same time, if the reverse lever is advanced a whole notch on the quadrant, more steam may be supplied than is needed, in which case the throttle must be partially closed. To meet this difficulty a supplementary lever *B* and quadrant *C* are attached to the ordinary reverse lever *A*, *A*. By this means the position of the link and point of cut-off can be fixed at five or more intermediate positions between each two of those due to the notches in the main quadrant. An engine runner can thus have the fullest control of his valve gear, and by this mechanism can exactly and instantly graduate it to the work to be done.

Quite a number of contrivances to accomplish the same purpose have been devised in both England and Germany, but in every case the arrangements—such as screw reversing gear and other similar contrivances—have interfered with the free and quick movement of the reversing lever, which is absolutely necessary for safety. The plan which we illustrate secures all the advantages required, without any of the objections named, inasmuch as the ordinary lever is retained, but so arranged with the auxiliary lever that the facility of reversing and ease of handling is in no way interfered with. The small lever simply does what the larger one is of itself unadapted for. This invention enables the fullest expansive value of the steam to be obtained that is possible with the appliances afforded by the engine on which it is used, and it is claimed that thus a saving may be made in the fuel consumed, which in a few months will equal the whole cost of the improvement.

Mr. Wm. A. Robinson, the Mechanical Engineer of the Great Western Railway of Canada, is the inventor and patentee, but Mr. B. W. Healey, Superintendent of the Rhode Island Locomotive Works, is agent for supplying the improvement or licenses for it use.

THE following incident illustrative of the manner in which some public works are carried out under the care of the Public Works Department Engineers of the Madras Presidency, is worth recording. We give it on the authority of an Indian engineer. About twenty years ago there was commenced a bridge in Madras to carry the general traffic across a "nullah." Long before it was finished the estimates was exceeded, and the work was abandoned. After a lapse of years additional funds were granted, and the bridge was proceeded with by another engineer. It so happened that the engineer who had commenced the bridge had made a bench mark upon a tree adjacent, and as nature worked faster though more quietly than the Public Works Department, the tree grew, and with it the bench mark grew also, higher and still higher from the ground. Now, whether the engineer in charge of the completion of the work drew his inspiration from headquarters, or whether he was actuated solely by his own bright instincts, we know not, but at all events he worked to the bench mark. The consequence was that the bridge was carried up some ten or twelve feet higher than was originally intended, the estimates were again exceeded, and a good deal more money was required for the completion of the approaches. But, as this money was not forthcoming, the bridge was rendered useless, and the traffic had to be conveyed across the nullah as of yore, whilst the bridge towers aloft a monument to the Public Works Department and its officers.—*Engineering.*

Northern Pacific.

The contract by which this company became one-half owner of the Duluth property of the Western Land Company has been completed by the payment to the land company of the $120,000 stipulated.

The contract with the Northern Pacific corporation for the sale or perpetual lease to it of half the line of the Lake Superior & Mississippi Railroad, between Duluth and the Junction, has been so far perfected that the directors of the last mentioned company have formally santioned it, and the formal indorsement of it by the directors of the Northern Pacific is expected to be given at their next meeting.

Contributions.

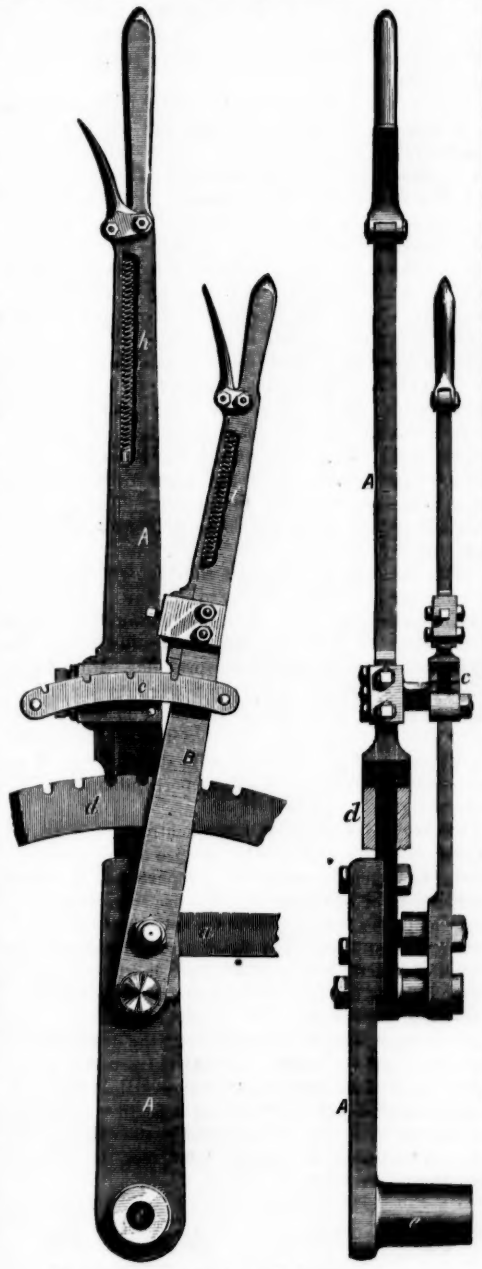
SIMPLE RULES FOR LOCOMOTIVE ENGINEERS AND MACHINISTS.

[Continued from Page 602, Vol. II.]

The entire calculation of the effects of gravity, as developed on railroad grades, belongs to quite an advanced practice of engineering. There is nothing about it either difficult or uncertain, however, and an operative engineer may, if he chooses, as readily determine the duty of his locomotive, or any pitch of grades, as the most accomplished graduate from the civil engineering course.

In treating of this subject in my previous article, I showed the principle of the inclined plane, as one of the mechanical "powers," to be, in substance, as follows:

Leaving out all consideration of friction—which is wholly independent of gravity—the resistance of any



Improved "Graduator or" Reversed Lever.

weight or load to ascending motion, upon any grade, is that fraction of the load itself which is formed by the height of the grade divided by its length. In other words, the opposing gravity of any weight on any grade is in the same proportion to the weight as the rise of the grade is to its own length. A part of the present article will be devoted to illustrations of this principle.

A mile is 5,280 feet. If a mile of road be perfectly horizontal, a load at any point on its length would be wholly supported by the rails, and would have no gravity in opposition to motion. If a mile of road was supposed to be *perpendicular*, it would support no weight whatever; a load passed over it would be lifted 5,280 feet, with an opposing gravity just equal to its own weight. If a mile of road be inclined to rise 2,640 feet from a horizontal line, any load moved upon it would be one-half supported by the road, and would have an opposing gravity equal to one-half of its own weight.

Thus, with a grade of 40 feet per mile, $\frac{5240}{5280}$ of the weight are supported by the track, and the remaining $\frac{40}{5280}$ form the opposing resistance of gravity. So of any other grade. The pitch of grade merely fixes the proportion of the weight or load which must be lifted, in distinction from that supported by the road.

We thus see that the gravity of any weight on a grade of *one* foot per mile, is $\frac{1}{5280}$ part of itself. If the weight assumed be one ton of 2,000 lbs., $\frac{1}{5280}$ part will be the decimal .3787 of a pound, the remaining 1,999.6213 lbs. being supported by the track. If a ton of 2,240 lbs. be taken, which is the "long" ton of the iron and coal trades, its gravity at a grade of one foot per mile will be the decimal .4242 of a pound; the remaining 2,239.5758 lbs. being supported by the track. This illustration, showing the gravity respectively of a "long" and a "short" ton, on a grade of *one* foot per mile, enables us to learn easily the gravity of any weight on any grade. For this purpose I repeat the rules given last week:

RULE 1. For tons of 2,240 lbs., multiply the number of tons of load by the number of feet rise per mile, and multiply the product by .4242, and point off four places for decimals. The result is the gravity.

RULE 2. For tons of 2,000 lbs. follow the above rule substituting .3787 for .4242.

The other points established or advanced in my last article are these:

Gravity is greater as the grade is steeper and as the load is heavier. The gravities of two loads, on different grades, are thus exactly to each other as are the respective products obtained by multiplying each load in tons by the feet per mile of the grade on which it is carried. A load of 100 tons on a 40-foot grade has four times the gravity of another of 50 tons on a 20-foot grade.

Gravity is entirely independent of all other resistances, and all other resistances to railroad locomotion are quite as independent of grades. Nothing can ever change the law of gravitation, and nothing consequently can ever reduce the resistance of gravity of a given weight on a given grade. Other resistances can be reduced by improving the construction of railroads and carriages; that of gravity is unalterable.

Were gravity the only resistance on grades, the tons carried up by the same amount of power, on different grades, would be inversely to each other as the rise of the grades in feet per mile. Twice as much would go up the 50-feet grade as on the 100-feet grade. But as all other resistances besides gravity are independent of grades and vary at given speeds mostly with the load, it follows that more power would be required to draw, say 100 tons up a 50-feet grade, than for 50 tons up a 100-feet grade.

We have thus arrived at a tolerably comprehensive view of the absolute resistance of grades. The most important inquiry, however, is their relative resistance when compared with other resistances.

By our rule, the gravity of one ton on a 42-feet grade, for instance, will be found to be nearly 16 pounds. If, now, the ordinary resistances of friction, concussion, etc., were unavoidably equal to 64 pounds, the resist- of a 42-feet grade would be relatively small, and the power which would carry 5 tons on a level would carry more than four tons on such a grade. But if the ordinary resistances to horizontal motion were but 4 lbs. per ton, the relative disadvantage of a 42-feet grade would be very much greater. The power which would carry 5 tons on a level would carry but little more than one ton on an assumed grade. In either case the absolute resistance of the grade is the same, but in one case it is but a small part of the whole resistance; in the other it is a very large one. In the first case it forms but 20 per cent. of the whole resistance; in the second case it is 80 per cent. If a power of traction equal to 8,000 pounds were employed in each case, we should have 100 tons drawn in the first case, the gravity of which would be 1,600 pounds, and the other resistances of which would be 6,400 pounds. In the second case we should have 400 tons drawn, with an entire gravity of 6,400 pounds, and a sum of other resistances of 1,600 pounds. The more perfect, therefore, the condition of the railroad tracks and cars, the greater is the relative disadvantage of grades.

The relative resistance of grades depends also upon another circumstance, besides that of the absolute condition of road and cars. While the resistances of grades vary with their pitch, other resistances to motion vary with the velocity. We do not mean merely to say that at twice the velocity the same resistance is overcome in one-half the time, but it must be understood that the actual resistances of moving bodies increase with increase of speed. An engine, in doubling its speed, with a given load, does not only overcome a given resistance in one-half the time previously taken, but it encounters

an absolutely greater resistance at any one moment of time.

As the resistance to horizontal motion is increased, the relative resistance of grades is diminished. The increase of resistance with increase of speed is very decided, from speeds of forty miles an hour upwards. The atmospheric resistance, which is quite insignificant at low speeds, increases as the *square* of the speed—that is, it is four times greater when the speed is increased ten-fold, and so on. When it once, then, attains a respectable amount, it increases with great rapidity, until it becomes *the* great resistance to motion.

On the level, with a certain weight of load, the resistance has been known to increase from 14½ lbs. per ton, at 20 miles an hour, in a proportion which would have reached 76½ lbs. per ton, at 100 miles an hour.

Thus, the resistance of grades is relatively diminished with increase of speed. A fast passenger train overcomes a given grade with a relatively less expenditure of power than would a slow freight train; although the absolute expenditures, for a given weight, is the same in each case.

In the foregoing remarks, we have been dealing with power, as measured in pounds or tons. Should we look upon it in an economical point of view, and estimate it upon a basis of dollars and cents, we should be prepared to show that the relative disadvantage of grades depends also upon the capacity of motive power, or upon the relation between the power put in use and the resistance to be overcome.

I have not yet explained how the engineer is to estimate the power of his engine on different grades; but all that I have said has been preparatory to that purpose. Everything said, thus far, is necessary to be known before the application of our rules could be comprehended; and I do not mean to give rules merely, without explaining the principles on which they depend. F.

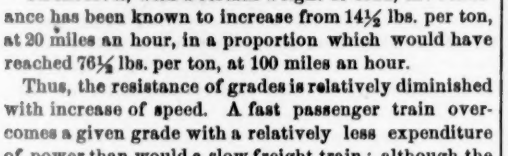
LINEAR MEASUREMENTS WITH TELESCOPE AND ROD.

Engineers accustomed to use the stadia in determining distances will perhaps find nothing in this article to interest them; I only hope to direct the attention of those engineers and surveyors who have never employed it to this beautiful and excellent method of measuring lines, and to develop as simply as possible the practical formulæ and methods of proceeding which, the experience of competent men in the profession has demonstrated, may with advantage be adopted. I apprehend that but few, in the class referred to, realize with what rapidity and accuracy, under favorable circumstances, distances may be measured by the method under consideration, and how much, by its use, the time, labor and expense of field work may be abridged.

It cannot by any means displace the chain, but may frequently with advantage be employed, even when the chain also is used, as a check upon chain measurements.

In determining distances with a stadia and transit, or level, the diaphragm of the telescope must be provided with at least two horizontal hairs—usually made movable by small capstan-headed screws—which may be placed at such a distance apart, as, for example, to intercept ten feet on a rod held at a distance of 1,000 feet from the instrument. Then for any other point the distance can be read off distinctly; for the space intercepted on the rod by the horizontal hairs will be the distance from the instrument in hundreds, and decimals of hundreds, of feet.

Fig. 1.



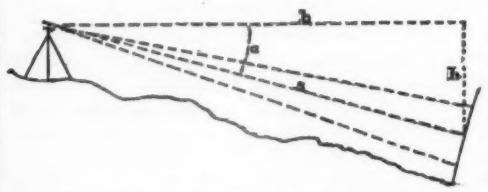
If the line of sight makes an angle with the horizon, either above or below it, the instrument must be provided with a "vertical limb" for noting this angle of elevation or depression. This angle being read off, and the rod held perpendicular to the line of light, the horizontal distance will be equal to the oblique distance multiplied by the *co-sine* of the angle of elevation or depression. If the vertical distance above or below the plane of the instrument is required, we have simply to multiply the oblique distance by the *sine* of the same angle.

Let a denote the angle of elevation or depression; s, the oblique distance; b, the horizontal distance; h, the vertical distance. Then $b = s \cos. a$ .....(1.)

$h = s \sin. a$ .....(2.)

The speaking rod is usually employed with the divisions very plainly marked. It may be adapted both for leveling and for stadia work, by dividing and numbering one side in the usual manner, and marking off the

Fig. 2.



opposite side much more distinctly into tenths and hundredths of feet, and numbering them from the top downward. The observer may then bring the upper horizontal hair to the top of the rod, and note carefully the division on the rod cut by the lower horizontal hair. Or two targets may be used, the upper one being set at 2,000, and the lower one moved up or down the rod until it meets the lower hair, the upper hair being fixed on the upper target. The lower target then gives the reading, and hence the distance. A variety of forms of dividing the rod are used; the above are given simply as illustrations.

For measuring underground, in mines, the stadia has been found to be more exact than and altogether preferable to the use of the chain. To do this, some form of "lighted rod" must be employed. It may consist of a hollow box made of three boards five feet long and four inches wide, the fourth side of glass, varnished and covered with tissue paper on which may be painted the divisions and the numbers. A light placed inside will illuminate the front and thus render the divisions distinctly visible. The preceding discussion assumes to determine the distance to the centre of instrument. Strictly however it gives the distance only to a point in front of the object glass, a space from it equal to its focal length. Hence for greater exactness we must add to the distance already determined this focal length, (equal to the distance from the "cross hairs" to the object glass) increased by the space from the object glass to the center of the instrument. The reason of this will appear when we come to discuss the exact formulæ.

With care and practice the rodman will succeed in holding the rod perpendicular to the line of sight with considerable accuracy. A large right-angled triangle or try-square may be used with advantage, the short side of the triangle being provided with a flange. Then the rodman can apply the triangle to the rod, so that the flange rests against the back of the rod, and sight along the other side, moving it, with the rod, until it corresponds in direction with the direction of the telescope. Then the rod will be perpendicular to the line of sight.

It is very convenient, and frequently sufficiently accurate, to obtain distances by the use of the "traverse table," or table of latitudes and departures, calculated to distances of one hundred. To use such a table, we first obtain the oblique distance, note the angle of elevation or depression, then the horizontal distance may be found directly in the table; since it will correspond to the latitude of which the observed distance and angle constitute the course. The vertical distance, in the same manner, would correspond with the departure. If the rod is held vertically, a double correction is necessary; *i. e.*, to obtain the horizontal and vertical distances, we must look out the latitude and departure of the first *latitude* and *departure*. *E. g.* Suppose the reading to indicate a horizontal distance of 1,284 feet, the angle of elevation to be 6° 45′:

Bearing. 6° 45′	Distance. 1,284	Lat. 1,275.42	Dep. 151.00
6° 45′	1,275.42	1,267	149.86

Hence the horizontal distance=1,267 ft., and the elevation—149.86 feet.

We will now consider the exact formulæ:

Fig. 3.

Let c denote the object glass; f, its focal length; h, the space intercepted between the center cross hair and the upper hair; n, distance between the cross-hairs (=size of image formed by object glass); and let y be distance of image from the object glass. The general formulæ for the *foci* of lenses gives $\frac{x}{y} = \frac{x}{f} - 1$; x being the distance to the object. And a comparison of the similar triangles in the fig. 3 gives $\frac{x}{y} = \frac{h}{n}$. $\therefore \frac{h}{n} = \frac{x}{f} - 1$. $\therefore x = \frac{f h}{n} + f$ (3.)

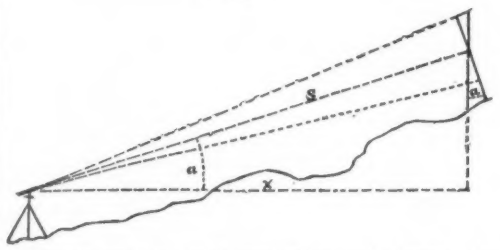
This gives the distance, x, to the object glass. Denote by k the distance from the object glass to the center of the instrument, and by x' the increased value of x, and we have the final formula, $x' = \frac{f h}{n} + f + k$.....(4.)

Usually the distance is so large that $f+k$ may be neglected, and we have: $x' = \frac{f h}{n}$. But in any case, if we wish for accuracy, we have simply to add these constants. f, n and k may be obtained once for all—k being the distance from the object glass to the center of the instrument, and f the distance of the object glass to the cross hairs. They may be measured directly in the instrument; n, being the space between the cross hairs, may be determined by measuring a distance upon the ground, say 200 feet, the rod being held up at one end, and the instrument set up at the other extremity, we have, denoting by r the reading of the rod, and by b the length of the measured base: $b = \frac{r f}{n} + f + k$. $\therefore n = \frac{r f}{b - f - k}$. In which all the quantities are known except n. If we substitute this value of n in equation (4), we have:

$x' = f h + (\frac{r f}{b - f - k}) + f + k = \frac{h}{r} (b - f - k) + f + k$...(5).

Which is the final equation applicable to all horizontal distances. But in measuring up or down slopes, this formula must be modified, as in the previous case, by the cosine of the angle of the slope.

Figure 4.



Let the rod be held vertically, and denote the angle of the slope, which is equal to the angle which the rod, held in a vertical position, makes with the rod held perpendicular to the line of light, by a; let h denote the space intercepted on the rod held vertically, h' the corresponding space on the rod held perpendicular to the line of sight; x and x' as before. Then $x = s \cos. a$, and $h' = h \cos. a$. But $s = \frac{f h'}{n}$. $\therefore x = \frac{f h'}{n} \cos. a = \frac{f h}{n} \cos.^2 a$. Adding the constants previously considered, $(f + k)$, which, being oblique, must also be multiplied by the cosine of the angle, and we have: $x' = \frac{f h}{n} \cos.^2 a + (f + k) \cos. a$ .....(6)

But since the angles taken are usually small, and since the cosine of a small angle is nearly equal to unity, $(f + k) \cos. a$ approximately equals $f + k$. $\therefore x'$ would become, neglecting the cosine, $x' = \frac{f h}{n} \cos.^2 a + f + k$ .....(7).

That is, the horizontal distance to any point situated above or below the plane of the instrument is equal to the product of the constant $(\frac{f}{n})$ by the space intercepted by the cross hairs, multiplied by the square of the cosine of the angle of elevation or depression, plus the focal length of the instrument, plus the distance from the object glass to the centre of the instrument.

To obtain the vertical distance above or below the plane of the instrument, we have, calling this distance d: $d = s \sin. a = \frac{f h'}{n} \sin. a = \frac{f h}{n} \sin. a \cos. a = \frac{f h}{n} \frac{1}{2} \sin. 2a$ .....(8).

As before, adding the constant $(f + k)$ and multiplying it by the sine a, we have, d' denoting the increased value of d: $d' = \frac{f h}{n} \frac{1}{2} \sin 2a + \sin a (f + k)$...(9)

But, since sine a $(f k)$ is a small quantity, it may generally be neglected, leaving the value of d as in formula (8).

From formula (6) and (9), as originally deduced by Prof. S. W. Robinson, formerly of Michigan University, and now in Illinois State Industrial College, a volume of tables has been calculated and published, and are used very much as an ordinary traverse table is used in surveying. These tables are now in use on the United States harbor improvements and very much facilitate the application of these formulæ.

Long distances, of several thousand feet, may be determined by using a level or theodolite and turning the telescope one-fourth the way round in the Y's, so that the horizontal hairs become vertical. Then cause the rodman to set up two stakes at a point whose distance from the instrument is to be determined, one in line of each of the hairs. Measure the distance between the two staffs, and proceed in the same manner as if it had been a vertical reading. A transit for this purpose may be provided with two extra vertical hairs. I have known this method to be employed by laying the instrument on its side in order to obtain the reading.

We may approximate to the limit of exactness within which it is safe to conclude that distances may be measured with the stadia. If the hairs are adjusted to intercept

one foot on the rod, corresponding to 100 ft. horizontal distance, then each $\frac{1}{100}$ of a foot on the rod will correspond to one foot of distance.

Now it is established the naked eye will distinctly distinguish an object at a distance of more than 6,000 times the diameter of the object. Assuming this as a safe estimate, it follows that $\frac{1}{100}$ of a foot, distinctly marked on the rod, will be plainly discernible by the eye at a distance of 60 feet, and hence through a telescope which magnifies 20 times, as an engineer's level, a distance of 1,200 feet; or through one which magnifies only 10 times, as an ordinary surveyor's transit, a distance of 600 feet. Since the cross hairs would bisect this $\frac{1}{100}$ division, it could not be more than $\frac{1}{200}$ of a foot from the true reading in the distance of 600 feet; and this $\frac{1}{200}$ would correspond to 6 inches of distance: which error, if it occur, may be considered to be the greatest that could arise in determining a horizontal distance of 600 feet with a telescope magnifying ten times. And with a telescope magnifying twenty times the limit of error would be one-half of the above; thus, in either case, being far within the greatest possible exactitude of the average chaining of well-instructed and careful chainmen. But since the observations are as likely to fall short as to overrun, it will be found that, in measuring a line by this method, if a number of observations be taken, the errors, if any, will tend to correct each other. I might relate a number of instances, showing remarkably that the above statement is borne out by the results of successful practice.

Altogether, the methods of measuring distances by the use of the stadia are so simple and practical, so cheaply and rapidly performed, so comparatively accurate and reliable, that it seems certain that they will ere long meet with general acceptance, not only with engineers, but among land surveyors also, and, in fact, by all persons interested in the measurement of lines.

C. D. Lawton.

University of Michigan, March 1, 1871.

CAR TRAVELING—EVILS ATTENDANT—REMEDIES SUGGESTED.

In Nos. 24 and 25 of the last volume of the Railroad Gazette an attempt was made to point out some of the ills encountered in rail riding and possible remedies therefor. Many other abuses and reforms remain to be noticed—a few of which are referred to below.

Car peddling being biggest and foremost among these ills, and not easily avoided, may as well be considered first.

Originally, this business was carried on by little boys—"only sons of poor widows"—who earned an honest penny by selling papers to the news-hungry traveler. But, like the express business, and other tall oaks, this calling has changed character and control entirely, and is now neither a newspaper or boy affair at all, and is detested by most people, for the same reason that they hate a big dog—although a pet, perhaps, while only a puppy. The thing has become a pest and nuisance, indictable at common law, for permitting which, railroad managers ought to suffer—a blush of shame at least. The news-*boy* is abolished, and we have instead a sturdy compound of persistence and impudence, who is instructed by employers to abolish "news" also—as far as may be. He sells every thing but newspapers; these are inhibited for the same reason that the learned bear was famished by his master—abstinence begetting an appetite for any anything offered, however repulsive.

Permitted plum-pudding and pies, Madame Parsnip's boarders might revolt at unlinneal hash and stale biscuit; and by the same token, when a bookseller has a stock of antiquated yellow-covers and vermillion "confessions" of long forgotten pirates and rope-danglers, and has bought the privilege of pestering the public with these decayed possessions, he is not so verdant as to clog his market with something better before that which he is most anxious to sell has had a chance. Hence, news is prohibited by our new-fangled news-*boy*—of necessity. And if *asked* for this *sine qua non* of every well-bred traveler, ten to one the traveler gets only an impertinent answer, or a prodigious variation from fact, for his inquiry. He forgets his position and by such inquiries makes trouble for his temporary owner and keeper; for, it must be remembered, this dealer in pea-nuts and pictured gallows scenes has a proprietary interest in the day's passenger list—be the same more or less. He pays the company roundly for the privilege of plundering the load, and he is not to be diverted therefrom by any squirming or protests whatever on the part of his victims. If you want anything, you must buy it of him and at his price, or do without while on *his* car. At any rate he allows no other trader nor any sort of competition on the premises; and pie women and peach peddlers, etc., understand very well the perils incident to the locality—and avoid it.

Nor is extortion in price and cheating in quality his only resource. He pays for a chance at your claret, and must realize in some way—if he can. So other devices are in reserve when you decline a greenback investment in any of the goods offered. He proposes to make your fortune, although you do not help to make his, and expects a due degree of gratitude when this, his kindness, is fully demonstrated. He has a "*prize*" package—stationery, maps, and jewelry of unknown value—all of which you may possess for a mere bagatelle; or, that not suiting, he will hand you for fifty cents a large box of candies, every one of which has some silver or gold coin in it, and you *may* draw a bright quarter eagle in *gold*, for the dirty half-dollar stamp which is a disgrace to any gentleman's pocket—most certainly!

Many children and silly people thus invest in a "chance game" who would put no money at all in simple candies or "packages" containing no prizes of any value. And a rail car thus becomes the gamblers' "infant school," where the taste for fortune and faro are cultivated together, and "Young America" takes the incipient step, perhaps, towards the gaming table and the—penitentiary. It would at any rate be very hazardous to place the young man in sight of dice and sweat-cloth after (as boy) he had drawn a twenty shilling piece from a box of prize candy. He would be very apt to try his luck again, and possibly with money belonging to another.

Games of this kind are all illegal, and illegal because immoral, and immoral because *intrinsically wrong*. They are inimical to honest industry, degrading and criminal; and a railroad company (as is the landlord) should be held amenable for permitting such a fool-trap upon any of its cars or other premises. Baggage is not always at risk of the owner, and if these common carriers are answerable for the mere property entrusted to their custody, are they not still more actionable for the moral leprosies and defilements contracted by our children and dependents while temporarily under their control?

Of course, such an evil has neither defense nor defenders. Railroad officials are generally good citizens and gentlemen, interested, as are we all, in the well-being of society. They will not defend, even if they tolerate, anything of the kind.

Else—who would contemplate the gulf thus opened? If passengers are but so many silly geese, to be plucked and plundered by him who bids best for the privilege, why may not other "chevaliers"—the pick-pocket, the confidence man and the libertine—throw in a bid also, and buy an indulgence from the powers which secure the candy lottery and gift enterprize in their immunities? It won't do.

Still other consequences crowd upon the attention. To what end is the young man, thus emerging upon life's activities, naturally tending? Familiar with deception and fraud, and taught to believe that deceit may lead to ultimate success—who so likely as he to become a shover of "queer" currency, to test the strength of safe locks, to garrote an express messenger, or find a zebra suit at length which shall thereafter mark him as an enemy of society and all that distinguishes man from a mere beast of prey? Some of the Reno gang, so summarily disposed of in a neighboring State, are said to have received their rudimentary training in the very school referred to above. Other graduates await similar distinction.

Not long since, an elderly and not over-intelligent woman, got into very high words with one of these car merchants on a Northwestern train for cheating in some of the wares sold her. The argument seemed to be with her entirely, while her *vis-a-vis* was content to enjoy the laugh alone.

"Oh," said he aside to a listener, "how I do like to 'come it' over these close-fisted and stupid country people. Why, that old woman supposed she was to secure a fortune by investing a quarter in a prize package, and is raging to find the opened catalogue a little short of her great expectations—only a little!" And the question arose in some minds—as it would again and again—Are these among the legitimate perils of the rail to be counted on and encountered whenever we commit our untraveled wives and daughters, or our confiding grandmothers, to the care and custody of a railroad company? Are these companies the guardians and protectors of the ignorant and weak within their purview, or only purveyors, supplying victims to harpies and vampires at a stipulated sum per head?

Questions of some moment to all concerned, certainly, and which a delayed answer will make more and more imperative. Pigmies assuming the proportions and parts of hydras challenge our instinct of self-preservation; and while dilating to the supposed size and mien of conquerors, they only become the marks of a more certain and speedy destruction.

The car peddling, cheating and gambling nuisance has had its day and must be abated.

Other forms of swindling, begging, etc., as practiced on rail cars, remain to be noticed; we may also discuss at another time certain sanitary phases of railroad life which have hitherto had little attention, but are of the utmost public importance.

Iron Point.

The Canada Southern Railway.

To the Editor of the Railroad Gazette:

A letter appeared in your last issue from Mr. Finney, Chief Engineer of the Canada Southern Railway, showing the great advantages of the location of that line. Yet parties in this country who know the particulars of that scheme do not regard it as likely to be carried through.

There are already two railways running parallel to this proposed line, and the Great Western Railway is actually engaged in building a third line, an air-line from Buffalo westward, which, for 150 miles, will run parallel and within two miles of the proposed Canada Southern, and for the balance of the distance the present main line of the Great Western is only from seven to eight miles distant.

The original scheme of this proposed Canada Southern was based upon the supposition that it would have the country it would run through to itself; but the Great Western obtained a charter for an air line, over the same line of country. The Canada Southern was also expected to receive aid by bonuses voted by the counties and towns through which it was to pass to the extent of a *million and a quarter* of dollars; but in this it has been disappointed, as the total amount voted is only about *four hundred thousand* dollars, which will go but a very short way to build 300 miles of railway.

What the prospects of the line are, you may be able to judge from the fact that there is only one small town of over 1,000 inhabitants through which it would pass, and as for the through business, you are aware that the Michigan Central and Great Western companies are virtually one concern, having an agreement to work together and in harmony for a term of years, so that to obtain any through connection it must build a railway through Michigan, of the probable success of which you know better than I can tell you. The idea of Mr. Finney that the Lake Shore will interchange traffic with it is of course very improbable, because they have their own line all the way from Chicago to Buffalo, and it would not suit them to part with the business half way, at Toledo or Detroit. Even before the Michigan Southern was amalgamated with the Lake Shore it never transacted any through business *via* Detroit; and since the amalgamation, it is, of course, still more unlikely that they will work their through traffic through Canada.

As attention is called in your valuable paper to the Canada Southern, I thought I would give you a few facts in relation to it which may be of interest to your readers.

With two parallel roads already running, and a third being built on the very line of this Canada Southern, what possibility is there of that company placing its bonds, when even legitimate schemes in your own country cannot be floated.

Of one thing you may be sure: they cannot sell a bond in Canada, where it is too well known that the existing railroads do not pay, one of the lines actually not paying interest on its bonds.

English capitalists have already sunk immense sums of money in the railways in Canada running through the country which this Canada Southern is to occupy, therfore it would be utterly useless to ask them to put money into the concern.

Canadian.

March 27, 1871.

Read with Single Rail.

Mr. J. L. Haddan, C. E., of London, has devised a single-rail tramway for conveyances in mountainous and thinly peopled countries, of which he gives the following description: "Imagine a bicycle let in a longitudinal aperture in the center of the bottom of a cart, and the cart nearly touching the ground, so that only about six inches of the wheels would be visible; next, a kind of balancing pole run through the sides of of the cart at right angles to the single rail on which the bicycle is to run. The two ends of the pole are to project about three feet on either side of the cart, and rest upon, and be harnessed to, the backs of two mules. The animals will thus be one at each side of the load, instead of being in front in the ordinary way. It would be impossible for the cart to turn over, because, in order to do so it would have to force one mule to the ground and to lift the other into the air; and, moreover, as its floor would only be six inches above the rail, an overtip would be of no account. All the weight in the cart, if evenly distributed, would bear upon the rail, and the animals having no load upon their backs, would be able to exert considerable tractive power."

RAILROAD LAW.

Responsibility of Railroads for the Misconduct of their Servants towards Passengers.—*Coarseness and profanity on the part of a brakeman, or other servant, constitute misconduct for which a company will be liable in exemplary damages, if such servant is retained after a knowledge of his conduct has come to the company.*

In a late number of the *American Law Register* we find a case reported, of such novel and marked interest, that we here condense it. This opinion is of importance to all railroad men. We also add a classical note of authorities which may be of value to the profession.

Charles W. Goddard vs. The Grand Trunk Railway Company. Supreme Judicial Court of Maine.

The facts in the case are these: The plaintiff, a highly respectable citizen, and a passenger in the defendants' railway car, on request, surrendered his ticket to a brakeman authorized to demand and receive it. Shortly after, the brakeman, without provocation, approached the plaintiff in his seat, and, accosting him in a loud voice, denied, in the presence of the other passengers, that he had seen or recieved the plaintiff's ticket, and in language coarse, profane and grossly insulting, called the plaintiff a liar, charged him with then attempting to evade the payment of his fare, and with having done so before; and leaning over the plaintiff, then in feeble health and partially reclining in his seat, and bringing his fist down close to his face, violently shook it there, and threatened to split the plaintiff's head open and to spill his brains right there on the spot, with much more to the same effect. The defendants, although well knowing the brakeman's misconduct, did not discharge him, but retained him in his place, which he continued to occupy at the time of the trial. The jury was instructed that the case was a proper one for exemplary damages, and they returned a verdict for $4,850, which the Court declined to set aside.

The court discusses the subject under the two heads of, I, The Carrier's Liability; II, The Measure of Relief.

I. *The Carrier's Liability.* The defense of the company was that, inasmuch as the brakeman's assault was willful and malicious, and was not directly nor impliably authorized by them, they were not liable. The Court declare this argument a fallacy, in that it does not discrimate between the duties the carriers owe to a stranger, and the obligation which he is under to his passenger. The Court says:

"The carrier's obligation is to carry his passenger safely and properly, and to treat him respectfully, and if he intrusts the performance of this duty to his servants, the law holds him responsible for the manner in which they execute the trust. The law seems to be now well settled that the carrier is obliged to protect his passenger from violence and insult, from whatever source arising. He is not regarded as an insurer of his passenger's safety against every possible source of danger, but he is bound to use all such reasonable precautions as human judgment and foresight are capable of, to make his passenger's journey safe and comfortable. He must not only protect his passenger against the violence and insults of strangers and co-passengers, but *a fortiori*, against the violence and insults of his own servants. If this duty to the passenger is not performed, if this protection is not furnished, but, on the contrary, the passenger is assaulted and insulted through the negligence or the willful misconduct of the carrier's servant, the carrier is necessarily responsible." * * * * * * "It is not sufficient that the servants are capable of doing well, if in fact they choose to do ill; that they can be as polite as a Chesterfield, if, in their intercourse with the passengers they choose to be coarse, brutal and profane. The best security the traveler can have that these servants will be selected with care, is to hold those by whom the selection is made responsible for their conduct.

* * * * * * "The law requires the common carrier of passengers to exercise the highest degree of care that human judgment and foresight are capable of, to make his passenger's journey safe. Whoever engages in the business impliedly promises that his passenger shall have this degree of care. In other words, the carrier is conclusively presumed to have promised to do what, under the circumstances, the law requires him to do. We say conclusively presumed, for the law will not allow the carrier by notice or special contract even to deprive his passenger of this degree of care. If the passenger does not have such care, but, on the contrary, is unlawfully assaulted and insulted by one of the very persons to whom his conveyance is intrusted, the carrier's implied promise is broken, and his legal duty is left unperformed, and he is necessarily responsible to the passenger for the damages he thereby sustains."

1. *Rule of damages.*—The Court affirm with great emphasis the right of a jury to give exemplary damages in such cases, and manifest some littleness toward corporations. The judgment is affirmed as "an impressive "lesson to the defendants and to the managers of other "lines of public travel."

LAW NOTES.—I. *Carrier's Liability. Per Curium. Howe vs. Newmarch*, 12 Allen, 55; Angell & Ames on Corp., § 388, p. 444, 8th ed. *Brand vs. Railroad*, 8 Barb., 368; *Moore vs. Railroad*, 4 Gray, 465; *Seymour vs. Greenwood*, 7 H. & N., 354; *Railway vs. Finney*, 10 Wis., 388; *Railroad vs. Vandiver*, 42 Penn., St. R, 365; 17 N. Y., 362; 14 How., 468; 7 Am. Law Reg., N. S., 14; 34 Conn., 554; 5 Louisiana, O. S., 275; 1 Clift, 145; 27 Md., 277.

Defendants Authorities.—Derby vs. Penna. Railroad Co., 14 How 468; *Howe vs. Newmarch*, 12 Allen, 56; Reeves' Dom. Relations, 356, 358; *Foster vs. Essex Bank*, 17 Mass., 508; 2 Kent's Com., 259, 260; Story on Agency, § 318; *Brown vs. Purviance*, 2 Harris & Gill, 317; *Lyons vs. Martin*, 8 Ad. & E., 514; *Thames Steamboat Co. vs. Railroad Co.*, 24 Conn., 40; 1 Redfield on Railways, 510–515; *Pote vs. Dill*, 48 Maine, 539, Rice's dissenting opinion; *Hagan vs. Prov. & Wor. Railroad Co.*, 3 R. I., 188; *Turner vs. N. B. & M. Railroad Co.*, 34 Cal., 594; *Pleasant vs. N. B. & M. Railroad Co.*, 34 Cal., 586; *Finney vs. Mil. & Wis. Railroad Co.*, 10 Wis., 338; *Clarke vs. Newson*, 1 Exch., 131; *Montford vs. Wadsworth*, 7 Ind., 83; *Ripley vs. Miller*, 11 Ind., 247.

II. *Measure of Damages.*—2 Wils., 205; Campbell's Lives of Lord Chancellors, Am. ed., vol. 5, 214; 5 Taunt, 442; 2 Stark, 317. 13 M. & W. So; 6 H. & N., 969; 2 Wils., 244; 3 Am. Jurist, 387; 13 How., 363; 1 Jones (N. C.), 98; 13 Iredell, 28; 10 Id., 67; 3 Johns, 56, 64; 36 Miss., 660. 36 N. Hamp., 9; 27 Md., 277; 2 Duvall, 556; 40 Miss., 374; 46 Barb., 222.

Common Carriers.—*Their liability for loss of baggage and freight—"Baggage" defined—Common carriers not obliged to carry money—If there is doubt about the contents of packages the consequences of such doubt fall upon the carrier, if he does not make inquiry.*

In the late case of *Dexter vs. The Syracuse, Binghampton & New York Railroad Company*, the Supreme Court of New York held, among other things, that:

Carriers of passengers are responsible for the carriage and safe delivery of such baggage as by custom and usage is ordinarily carried by travelers, and that the payment of the usual fare includes, in contemplation of law, a compensation for the conveyance of such baggage.

It is an error to claim that the baggage which a traveler may take, and the carrier must safely transport and deliver, is limited to such apparel or other articles as "were absolutely" necessary or material for his use, comfort or convenience on his journey, or while away from his home.

Such a rule would be too strict and narrow for these times, when steamboats and railroads have so wonderfully increased the temptations and facilities for travel, and superseded the old modes of transportation by stage coaches, canal and river boats, and other ways as means of transportation from place to place, formerly in use.

It would be a more fair rule to hold the carrier responsible for whatever he received as baggage from the traveler within such limits as to weight and amount as the carrier might fix and prescribe. Public carriers and the courts have been growing more liberal on this subject of late than formerly.

The rights of the traveler to recover of the carrier for lost baggage is not limited to such apparel or other articles as he expected to use or needed by the way.

As a general principle, that will not be considered "baggage" which has no necessary connection with the baggage which it is customary to allow passengers to carry for a journey. Money, beyond a very limited amount, is not baggage. Merchandise is not baggage.

In the case of *Kater vs. The Michigan Central Railroad Company*, it has recently been held that:

1. A clause in the charter of a railroad company requiring them to transport "all merchandise and property," does not oblige them to become common carriers of money.

2. Nor does the fact that they transported money for an express company, under a special contract, make them such common carriers, and subject to extraordinary responsibilities as such.

3. The general rule that the shipper is not bound to disclose to the carrier the kind, quality, or value of the property, and that, in the absence of notice, or fraud or artifice on the part of the shipper, the carrier is liable, notwithstanding there was no disclosure, must be construed and applied subject to the usual cause of business. If the property is put up or packed in a manner calculated to deceive the carrier, he does not become subject to extraordinary responsibilities as such; but if there is justly any doubt about the contents of a package, resulting from its examination or appearances, the consequences of such doubt must fall upon the carrier, if he does not make inquiry.

4. An emigrant having packed and shipped a quantity of gold coin in the center of an ordinary dry goods box filled with clothing and household goods; *held*, if this was calculated to deceive the company as to the value of the contents, and by no reasonable inference could they have supposed that the box contained coin, they are not liable as common carriers. If, however, the defendants knew that the parties emigrating, like the plaintiff, were in the habit of putting up valuable articles and money among their household goods, and from such knowledge might infer that the box of plaintiff might contain money, then it became their duty to make inquiry in order to relieve themselves from liability.

5. In every case where property is delivered to a carrier to be transported for hire, if the circumstances are such as to relieve him of his extraordinary responsibility as a common carrier, there is still an implied contract for ordinary care, he is not released from all responsibility, but becomes an ordinary bailee, the burden of proof being then upon the shipper to show negligence.

Negligence.—*Duty of roads as to keeping up fences—Not liable unless notice is given that fence is down—Keeping bars and gates closed.*

In the Supreme Court of Iowa a decision of much importance has been reached with reference to railroads and stock running at large. The facts were as follows:

The line of railroad is fenced on both sides; the bars were placed in the fence for the convenience of the land owners on each side of the road. These bars were left down by some one unknown. Near this point plaintiff's colt was found in the ditch fatally injured by a passing train. The evidence further showed that it was customary for defendant's hands to pass along the road and to put up the bars when they find them down, and supposed that they did so a short time prior to the accident. The jury below found for the plaintiff, and the Court refused to interfere with the verdict, but the Supreme Court set aside the verdict, holding that after a company has fenced its roads they are not liable for accidents arising from breaks or damage to the fence until after they have had notice of such damage, and a reasonable time to repair the same; that the same rule applies to gates and bars, the company being required to exercise only reasonable diligence in keeping the same closed; that the essential facts wanting in the plaintiff's case were that the company had knowledge of the fact that the bars were down and neglected beyond a reasonable length of time thereafter to put the same up. This makes it the interest and duty of persons using such bars and gates, as well as of the company, to keep the same promptly closed. The rule is a reasonable one which requires the companies to exercise reasonable diligence, but to make them liable for damages resulting from the negligence of others, and of which they have no knowledge, would be unjust.

Rule of Damages.—*Cattle inclosures—Cattle may run at large.*

The Supreme Court of Missouri, in *McPheeters vs. The Hannibal & St. Joseph Railroad Company*, has decided that it is not the law of Missouri that owners of cattle shall keep them inclosed. The Courts say:

"It is the law in England, and in some of the densely populated States in this Union, that the owners of cattle shall keep them inclosed, and if they stray therefrom they are trespassers, and the owners are guilty of negligence. But such is not, and never was, the common law in Missouri.

"It is opposed to the policy of the State in its present condition, and whenever it has been attempted to be enforced, it has met with resistance and condemnation. The question was elaborately considered in *Gorman vs. Pacific Railroad*, 26 Mo., 441, and it was there held that the owner of cattle is under no obligation to keep them on his own premises."

Right to Tax Capital and Net Earnings.—*A State has a Right to Tax the Capital and Net Earnings of Railroads unless there is a Specific Contract of Exemption—A State has no Right to Levy a Tax for the Use of Locomotives and Cars in Transit through the State.*

In the important case of *Minot vs. Philadelphia, Wilmington & Baltimore Railroad Company*, the Circuit Court of the United States, Delaware District, has reached a final decision. In 1868 the Legislature of Delaware passed an act imposing an additional tax on a proportion of the cash value of the capital stock and the net earnings of every railroad chartered by the State, and doing business therein, as well as imposing a tax for the use of every locomotive, car and truck owned by such company in whole or in part, and used at any time during the preceding year within the State of Delaware. The great question raised by the voluminous pleadings of the case was: Is this act constitutional so far as it imposes the tax mentioned within it upon the railroad? The Court held: 1. That the absence of an express exemption from future taxation there was no contract to that effect between the State and the company, and the State had the undoubted

right to assess the additional taxes upon the capital and net earnings. No such contract of exemption could be implied. 2. That the charge for the use of locomotives, cars and trucks, being indirectly a levy of a tax upon persons and property in transit through the State, is in conflict with the Constitution of the United States, as it is a regulation of commerce.

Papers on Iron and Steel.

BY W. MATTIEU WILLIAMS.

II.—THE BESSEMER PROCESS (CONTINUED).

In the first part of this paper* I described the facts of the Bessemer process, and now proceed to a theoretical examination of these. In order to do this at all satisfactorily, it is necessary to have, at the outset, a clear idea of the composition of the raw materials—the pig-iron and the spiegeleisen. I insist the more urgently upon this, because the descriptions or definitions of cast-iron or pig-iron usually given in our chemical text-books are by no means satisfactory, and are frequently erroneous.

The following are the results of my own analyses of fourteen brands of pig-iron and five brands of spiegeleisen, all of which are rather extensively used in the manufacture of Bessemer steel. In addition to the substances there determined, most of the pigs contain a small quantity of calcium, but this and the small traces of the metals of the other alkaline earths, and of the alkalis, were not determined, as the analyses were made for commercial purposes, and I have not been able to detect any practical modifications in quality of the finished iron or steel which is due to the presence of these metals in the pig-iron. For this reason the statement of "iron by difference" is but an approximation, and somewhat in excess.

COMPOSITION OF BESSEMER PIG-IRONS.

No.....	Combined Carbon...	Graphite...	Silicon.....	Phosphorus.	Sulphur....	Manganese.	Iron by Difference.
1	0.60	4.12	1.92	0.10	0.06	0.32	92.88
2	trace	3.52	3.10	0.07	0.06	0.34	92.95
3	0.70	2.68	3.60	0.09	0.12	1.16	91.65
4	0.55	1.85	3.60	0.13	0.18	1.22	92.47
5	0.55	1.92	3.65	0.09	0.18	none	93.66
6	0.75	2.00	3.36	0.10	0.13	trace	93.56
7	0.54	2.21	3.15	0.10	0.26	2.10	91.75
8	0.72	2.10	2.90	0.06	0.16	1.00	93.06
9	0.62	4.00	1.40	0.02	0.06	0.38	93.52
10	0.50	3.00	2.00	0.03	0.10	trace	94.37
11	0.80	2.80	2.33	0.12	0.10	1.92	92.63
12	trace	3.20	1.58	0.11	0.12	2.23	92.77
13	0.37	1.96	4.01	0.15	0.23	1.15	92.06
14	1.25	1.65	2.15	0.24	0.21	1.10	93.40

For commercial reasons, which will be readily understood, I abstain from publishing the names of the above brands. No. 12 is a Swedish pig-iron; all the rest are English hæmatite pig-irons made expressly for Bessemer purposes. Nos. 9, 10, and 11 produced exceptionally good steel; Nos. 1, 2, and 3, good average qualities; No. 4, inferior; No. 13, *very* inferior; No. 14 produced such bad steel that the whole parcel was returned, though it came from a well-known firm; it was of the same brand as No. 4.

COMPOSITION OF SPIEGELEISENS

No.....	Combined Carbon...	Graphite...	Silicon.....	Phosphorus.	Sulphur....	Manganese.	Iron by Difference.
1	4.10	0.45	1.23	0.12	0.16	4.60	89.34
2	4.10	0.40	0.96	0.03	0.26	5.86	88.39
3	4.50	0.40	0.88	0.04	0.10	9.61	84.47
4	4.10	0.42	0.65	0.05	0.15	8.64	85.99
5	3.00	0.70	0.14	0.04	0.07	6.44	89.61

No. 3 is the best of these; No. 4, the next in quality, rather better than average; No. 2, rather below average; No. 1, inferior quality; and No. 5 so poor that it was rejected.

Excluding the rejected samples, the average of the above is as follows:

AVERAGE COMPOSITION OF 13 BRANDS OF BESSEMER PIGS.

Combined carbon	0.47
Graphite	2.72
Silicon	2.84
Posphorus	0.08
Sulphur	0.14
Manganese	0 90
Iron by diference, about	92 85
Total	100 00

ATERAGE COMPOSITION OF FOUR BRANDS OF SPIEGELEISEN.

Combined carbon	4 20
Graphite	0.42
Silicon	0.92
Phosphorus	0.06
Sulphur	0.17
Manganese	6.63
Iron by diferenee, about	87.59
Total	100.00

The sulphur of this average of the spiegeleisens is excessive, being raised unduly by the very unusual quantity contained in No. 2: 0.12 per cent. would state the general average more correctly. In like manner the phosphorus average is raised by the excessive quantity in No. 1. Excluding this, the average is reduced to 0.04.

I will pass over the small amount of chemical change which results from the mere melting of the pig and spiegeleisen in the cupola, and regard the above as the composition of the material which enters the converter. When a mixture such as these Bessemer pig-irons is fused and exposed to the action of atmospheric air, the silicon is the most readily oxidized, silicates of iron and manganese are formed, which separate and float on the surface, forming the "cinder." The carbon oxidizes simultaneously with the silicon, but in a much smaller degree, until the silicon is nearly all burnt out. When the silicon is reduced below one per cent., the combustion of the carbon takes the lead, and the small remainder of silicon is but slowly oxidized, the last traces resisting oxidization with considerable stubbornness.

I have made some special investigations of this subject, and shall show in the course of another paper that manganese is remarkably efficient in removing these last traces of silicon. I should also mention that the above-stated generalizations respecting the prior combustion of silicon and the suppression of carbon combustion by the presence of unburnt silicon, are based chiefly on examinations I have made of the actions which take place in the "refinery;" the difference between the Bessemer converter and the refinery being, that in the one, air is blown upon or a little below the surface of the melted pig-iron, while in the other it is blown through it from below, and thereby acts with far greater efficiency and rapidity; the *kind* of action is, however, the same in both cases; the difference is only in *degree*.

In order to test the accuracy of the above conclusions, I have requested my late assistant at the Atlas Works, Mr. G. C. Barker, to make analyses of the Bessemer material during different stages of the same blow. This he has kindly done, and the following are his results. The carbon, silicon, sulphur, phosphorus, and maganese only are determined.

The first column shows the percentage of these constituents in the pig-iron after being melted, just before being poured into the converter.

Second, the same after six minutes blowing.

Third, the same after twelve minutes blowing.

Fourth, the same when the blowing was finished, but before the spiegeleisen was added.

Fifth, the finished steel when poured into the ingot molds.

	1.	2.	3.	4.	5.
Combined carbon	1.000	3.040	1.640	0.190	0.370
Graphite	2.570	trace	trace	trace	trace
Silicon	2.200	0.955	.470	trace	trace
Sulphur	0.177	0.091	0.098	0.093	0.090
Phosphorus	0.073	0.070	0.070	0.070	0. 59
Manganese	0.410	trace	trace	trace	0.540

We shall now be able to understand the changes I have described as occurring in the flame. Before the full combustion of the carbon can commence, there is about 2½ per cent. of silicon to be converted into silicic acid. In a charge of 6 tons this amounts to 3 cwt. For the complete combustion of this, nearly 3½ cwt. of oxygen, or about 14 cwt. of atmospheric air, is necessary. My explanation of the smaller and less brilliant flame that at first roars from the mouth of the converter is that it is mainly a silicon flame, mingled, however, with a small proportion of carbon flame; that the amount of silicon combustion goes on diminishing, and in a proportionate degree the carbon combustion increases, as the demand of the silicon upon the oxygen of the blast diminishes in consequence of its less abundant diffusion among the melted iron.

I shall not be surprised if this explanation is controverted, as in offering it I fly in the face of the spectroscope, which has made such glorious conquests that modern philosophers are disposed to trust it as implicitly as successful soldiers rely upon the general who has led them continually to victory; but without failing in due deference to those who are more skillful than I am in the use of this instrument, I am satisfied that in this and other cases where the question has been to determine the presence or absence of the *metalloids*, the *negative* replies of the spectroscope have been too hastily accepted. Prof. Roscoe, who devoted a considerable amount of time and labor to the spectroscope examination of the Bessemer flame, says, "Those who "are practically engaged in working this process would "like spectrum analysis to do a great deal more; they "would like to be told whether there is any sulphur, "phosphorus or silicon in their steel; questions which "unfortunately, at present, spectrum analysis cannot "answer, for this very good reason, that these sub-"tances do not appear at all as gases in the flame, but "that they either remain unvolatilized in the molten "metal, or swim on its surface in the slag of the ore; "and, consequently, the lines of these bodies are not "seen in the spectrum of the flame." Dr. Watt's observations and conclusions accord with those of Prof, Roscoe.

If, by the above, Prof. Roscoe is to be understood as asserting that no portion of the Bessemer flame at any period of its existence is due to the combustion of silicon, or that silicon is not present in the Bessemer flame, I must very decidedly affirm that such conclusion is erreneous. I do not for a moment question the accuracy of the observations of both Prof. Roscoe and Dr. Watts. I merely maintain that the absence of "the lines" of silicon in the spectrum of the flame does not prove its absence as a constituent in producing such flame, and for the following reasons:

We know that the silicon existed in the pig-iron in the proportion already stated, and that although a very small quantity of that which ordinary analysis detects may have existed as entangled silicate in the pig, and another small portion is of course oxidized in the cupola, the bulk of it enters the converter as unoxidized silicon, and that it is oxidized and converted into silicic acid during the blow. We also know that silicon when heated in air or oxygen burns brilliantly, and that the product of such combustion when heated with a blast such as that which supplies its oxygen in the Bessemer converter, is sufficiently volatile to form concretions in the throats of furnaces, which have been compared to natural chalcedony. Besides this a large quantity of solid matter is mechanically forced into the flame, and is seen above as a red smoke, which, without the slightest indication of unburnt carbon, is often sufficiently dense to hide the mid-day sun. The greater the quantity of silicon in the pig the more dense is this red smoke, which appears to consist of silicate and peroxide of iron. I maintain, therefore, that silicon is there, and that it must contribute to the luminosity of the flame, though it shows no characteristic "lines" in the spectrum.

Under such circumstances we have no good *a priori* reasons for looking for the silicon *lines;* a *continuous spectrum* being that which we are theoretically justified in anticipating as the result of such combustion of silicon, and this is exactly what the spectroscope reveals. The spectrum of the Bessemer flame at the commencement and early stages of the blow is of a most uncommunicative continuous character: occasional flickerings and vanishing ghosts of lines and bands come and go with perplexing irregularity; and even the brilliant and ever-obtrusive sodium lines do not appear at this stage, but commence with spasmodic flashings across the spectrum at about the period when the elongation and brightening of the flames, which I have described, is most decidedly taking place. When the flame has reached its maximum of extension and brilliancy, the sodium lines cease their intermittent flashings and become a steady stream of light, the lithium band appears (though not in every blow), and the whole spectrum becomes striped, but the continuous spectrum still remains as the permanent background.

My general reason for questioning the negative conclusions of the spectroscope in reference to the silicon and the other metalloids is, that these bodies usually give a continuous spectrum when, as elements, they combine freely with oxygen, as in direct, unrestrained combustion under ordinary pressure in the open air. It appears to me that there is thus presented a broad distinction between the spectra of the metals and of the non-metallic elements, which is of great practical importance, and which has not been sufficiently considered, when conclusions have been based on negative spectroscopic results. I have, already, in chapter 13 of "The Fuel of the Sun," referred to the worthlessness of the negative evidence of the spectroscope in reference to the non-existence of metalloids in the sun, and maintain that "they may all be there though the spec-"troscope should not detect one of them." The mere fact that nothing but metals (I include hydrogen with these) should have been discovered in the sun is very suggestive.—*Nature.*

* RAILROAD GAZETTE, Vol. 2, p. 461.

Railroads as Innovators.

When the subject of opening railroads in India was first discussed, says the Philadelphia *Ledger*, it was doubted whether the Hindoos would ride on them at all. But the natives take kindly to the innovation, and ride for the pleasure of riding. What is more curious than all, while the rich Hindoos go on pilgrimages, as their ancestors did, they do not, like those obsolete individuals, travel on foot, though foot-travel is the essence of pilgrimage. They take tickets for themselves and suites, and go by rail over the ground which their fathers toiled over on foot. Of course they have not read Peter Pindar, and did not borrow their labor-saving practice from the witty rogue, who, being sentenced to walk with peas in his shoes, "took the liberty to boil his peas." But human nature is the same in the Orient and in the Occident. Neither have Hindoos read Hawthorne's pleasant satire, "The Celestial Rail-"way," in which Christian, if we remember, put his grevious pack on the baggage car, and had it checked through. To publich a translation in Hindoostanee might be a pleasant speculation.

But, to look at the matter in a more serious light, we may well consider with an English writer, "how long "railways and pilgrimages will go on together and "what effect will be ultimately produced on the native "mind by these powerful agents of innovation." The subject will be a very interesting one for us to contemplate, at the distance of half the world's circumference. We can by comparing figures and statistics, approach some estimate of what this wonderful agent has done for Europe and America. We can hear the steam-whistle in the Russian note which has alarmed all Europe. We can understand that, within the last twenty-five years steam has put Russia in a far better condition to assume belligerency than even Russian victory, instead of defeat, in the Crimea could have done. We see the immense advantage railroads give to the European armies; and we know what vast use has been made of them in material operations in our own country. The better uses of railways we are now testing in civil pursuits and peaceful business. From all these considerations we can turn with a clearer observation to the history of railways in Asia. Deserts will be in a sense removed, and tribes and nations who have for centuries known each other only by report, if at all, will be brought face to face. What is more important, the Asiatic will be brought to the knowledge, and thence to the adoption, of European modes of business and avenues of knowledge. Fifty years of railways will do more in the transformation of India, and eventually of China, than has been effected in all the time which has elapsed since the Western nations forced their presence and their rule upon unwilling peoples. In future years the practical acts of Europe may enable the Orientals to reassert their independence, and to maintain themselves against the world, under conditions which will make them the equals of their present foreign masters and rulers.

—Mr. Amos T. Hall, Treasurer of the Chicago, Burlington & Quincy Railroad Company, filled the pulpit of the Universalist Church in Aurora, both morning and evening, last on Sunday, the 19th ult. Mr. Hall is now a resident of Hinsdale, but was for many years a citizen and for some time Mayor of Aurora.

RAILROAD GAZETTE

PUBLISHED EVERY SATURDAY.

CONTENTS.

Editorial Announcements.

Correspondence.—We cordially invite the co-operation of the Railroad Public in affording us the material for a thorough and worthy Railroad paper. Railroad news, annual reports, notices of appointments, resignations, etc., and information concerning improvements will be gratefully received. We make it our business to inform the public concerning the progress of new lines, and are always glad to receive news of them.

Inventions.—Those who wish to make their inventions known to railroad men can have them fully described in the RAILROAD GAZETTE, *if not previously published,* FREE OF CHARGE. *They are invited to send us drawings or models and specifications. When engravings are necessary the inventor is expected to furnish his own engravings or to pay for them.*

Articles.—We desire articles relating to railroads, and, if acceptable, will pay liberally for them. Articles concerning railroad management, engineering, rolling stock and machinery, by men practically acquainted with these subjects, are especially desired.

Engineering and Mechanics.—Mr. M. N. Forney, Mechanical Engineer, whose office is at Room 7, No. 72 Broadway, New York, has been engaged as Associate Editor of this journal in charge of these departments. He is also authorized to act as our agent.

☞ *Our Prospectus and Business Notices will be found on the last page.*

THE ILLINOIS CENTRAL REPORT.

The general balance sheet published in the report for 1870 shows $25,280,240 of capital stock, $16,640 of canceled bonds scrip, $6,869,500 of bonded debt, and $12,163,262 of bonds delivered to the Land Department, a total on the credit side of $44,329,642. This capital is represented by 707 miles of railroad in Illinois and the rolling stock with which the company works 402 miles of leased line in Iowa, *plus* the 415,610 acres of land remaining unsold in Illinois which, at the average rate at which the land was sold last year would be worth something more than ten times as many dollars. Aside from this land and the rolling stock of the Iowa leased lines, the capital represented per mile is $62,701. The earnings of the lines owned by the company were $10,200 per mile. As the working expenses and taxes amount to 60½ per cent. of the earnings, the net earnings per mile would be $4,025 per mile or about 6½ per cent. on the capital it represents, but a considerable portion of the interest on bonds is met by the receipts for land, which also have provided for the cancelation of more than $12,000,000 of the construction bonds up to the close of 1870. In addition to the lands yet unsold, there is due the Land Department for lands already sold on notes yet to mature nearly $3,000,000, and by the time the lands are all sold, the company's property will probably be represented almost solely by its capital stock, and its capital account per mile of road will be exceptionally small.

The earnings of the Illinois lines were at the rate of $10,200 per mile of road; of the Iowa lines, at the rate of $3,650 per mile. This last, however, is not a fair statement of the case; for 134 miles of main line were operated by the Illinois Central during only four months of the year. The average length of the Iowa lines was only 357 miles, and on this basis the earnings were $4,110 per mile. A detailed statement of the earnings of the Iowa leased lines shows that the receipts were $1,185,632.02, or $8,262 per mile, on the Dubuque & Sioux City Railroad (Dubuque to Iowa Falls), $140,672.41 on the Iowa Falls and Sioux City Railroad, or $768 per mile, and $141,100.98 on the Cedar Falls & Minnesota Railroad, or $1,744 per mile. As the average mileage of the Iowa Falls & Sioux City road was but 94 miles, it would be more indicative of the business of the line to give $1,496 as the earnings per mile per year of that portion of the line between Dubuque and Sioux City. Apparently, the operating expenses have not been calculated separately for each division; at least the statements given show 54⅛ per cent. of receipts for both the Illinois lines and the Iowa lines, and it does not seem probable that the latter, with their light traffic, have been operated as cheaply as the former, with receipts of $10,000 per mile. These Iowa lines, however, are likely to improve much faster than the Illinois lines; for they run through a half settled country, which is rapidly growing, much as the country on the Illinois lines was growing twelve and fifteen years ago, is of remarkable fertility, sure to have a large population, and heavy products very soon, and likely to remain tributary to the line now built. A railroad with fifteen or twenty miles of fertile prairie on each side of it (in this case there is more), which depends on that road for its sole route of transportation, will not long want for traffic.

A comparison of the business of the year with that of 1869 shows that while there was a slight increase in passenger earnings (about ⅗ of one per cent.), there was an increase in the mileage of passenger trains of about 8½ per cent., a decrease in the gross earnings of passenger trains (including baggage, mails, express, etc.) of 5-6 of 1 per cent., a decrease in the number of passengers carried of about 1½ per cent., and an increase in the average distance traveled by each passenger of about 3½ per cent.

In freight business there was a decrease of revenue of a little more than 2½ per cent., an increase in tonnage transported of 1¼ per cent., a decrease in the mileage of freight trains of 2⅛ per cent., a decrease in revenue per mile of road of nearly 7 per cent., and a decrease in the earnings per ton per mile of 6.8 per cent.

The revenue from local freights was more than *ninety-five and one-half per cent.* of the freight earnings; yet in this there was a decrease of 4.4 per cent., while in through earnings (probably because of the new line to St. Louis) there was an increase of more than 62 per cent.—the only very large increase during the year. The Illinois Central, however, like most of our Western railroads, and more than some of them, depends so much upon the local traffic that the value of the through business may be regarded as almost trifling, especially when it is remembered that the profit on this business is exceedingly small. If, however, we reckon the cost of doing this business at 60 per cent., the general proportion for all business on this road, the net earnings on through freight of the 1,109 miles worked by the company are only $109,933—not $100 per mile. This shows very strongly the importance of cultivating local traffic, and, we may say, the emptiness of the arguments of those who urge that a large and profitable business would be created by reducing local charges to the rate of through charges. We see here that the stimulus of competition and low rates to points where there is business to divert has had a trifling effect, if any, in attracting traffic, and certainly has not added materially to the company's profits.

The Illinois lines of the company run at right angles with the prevailing currents of traffic, and it is interesting to note the current of shipments on them. From the reports we learn that the tonnage northward was less by 9½ per cent. than the tonnage southward, and that the latter increased 14½ per cent. in 1870, while the former decreased 4⅓ per cent.

An idea of the importance of the company's business to and from Chicago may be gathered by the report of earnings from freight received and forwarded at this station during the year. The amount was $3,193,129.56—$1,460,790.90 on freight forwarded and $1,732,338.56 on freight received, which indicates that more than one-third of the freight was received at this place and four-thirteenths shipped from it. The total Chicago business amounting to $3,193,128, (counted twice, for there are both a receipt and a shipment for every charge), Dunleith follows with $922,022, then Cairo with $839,402 (a trifle more than a quarter of the Chicago business), then—with a long interval—Effingham, where the St. Louis connection joins, with $278,487. Following in order are Gilman (Toledo, Peoria & Warsaw crossing), $197,040; Warren (Mineral Point junction), $167,860; Mattoon (Indianapolis & St. Louis crossing), $165,489; Champaign, (Indianapolis, Bloomington & Western crossing), $164,586; Matteson (Joliet Cut-off crossing), $146,975; Tolono (Toledo, Wabash & Western crossing), $140,323; La Salle (Chicago, Rock Island & Pacific and Illinois River crossing), $138,207; Ashley (St. Louis & Southeastern crossing), $130,124; Duquoin (Belleville & Southern Illinois junction), $120,038; Kankakee, $106,295; Galena, $100,354; Bloomington (Indianapolis, Bloomington & Western crossing), $99,717; Dixon (Chicago & Northwestern crossing), $93,856. It is noticable that only two stations (Kankakee and Galena), which have no other railroad had a business of $100,000, and that of the thirteen crossings and junctions of the "main line" between Centralia and Dunleith, only four, Warren, La Salle, Galena and Dixon, appear in this category; while the total freight business of that part of the line, known as the Northern Division, was less than two-fifths of that of the Chicago & Cairo line, though the latter is but 23 miles the longest, one being 365 and the the other 342 miles long. This indicates very clearly that the "Chicago Branch" is in reality the main line. Its crossings naturally receive the bulk of the transshipments from east and west lines, whose traffic leaves them chiefly to go to Chicago, and rarely to go to Dubuque.

There are sixteen stations that received more than $25,000 for passenger fares. These are, Chicago, $279,174; Cairo, $149,656; Freeport, $102,119; Dubuque. $80,298; Effingham, $71,259; Mendota, $57,604; Mattoon, $42,587; Decatur, $42,282; Vandalia, $37,820; Champaign, $37,103; Bloomington, $33,969; Odin, $32,702; Pana, $32,533; Dixon, $31,601; Centralia, $30,815; La Salle, $28,453; Kankakee, $26,824. All of these stations, except the last, are crossings or junctions, except the three termini, Chicago, Cairo and Dubuque. The numbers of passengers southward and northward are very nearly equal, there being 12,500, or one in forty-six, more northward.

A full statement of through travel shows that the number of passengers from Chicago was 150 per cent. greater in 1870 than in 1869, and the number from Cairo to Chicago 50 per cent. greater. The whole number from Chicago to Cairo was 15,199 and from Cairo to Chicago 6,959, that is about 76 good train loads southward and 35 northward. The statement of through business of the "main line" shows that 121 passengers traveled from Cairo to Dunleith and 159 from Dunleith to Cairo, which is certainly not an overwhelming through business for a "main line."

A very interesting statement is made of the number of passengers delivered to and received from connecting lines in 1869 and 1870. The whole number delivered at the 23 connecting stations in 1870 was 102,286, against 97,504 in 1869, an increase of about 5 per cent. The number received from those lines was 94,619 in 1869 and 95,046 in 1870, an increase of less than ½ of 1 per cent. But there are considerable differences in the business with different lines, there being an increase of about two-thirds in passengers delivered to and one-third in those received from eastern lines at Chicago; an increase of three-quarters in deliveries and four-fifths in receipts to and from the Toledo, Wabash & Western at Tolono; an increase of nearly 200 per cent. in deliveries and 300 per cent. in receipts to and from the Vandalia road at Effingham, and of 1,000 per cent. in deliveries and of 600 per cent. in receipts to and from the same road at Vandalia (the business with this road was not begun until late in 1870); an increase of about 90 per cent in deliveries and a *decrease* of 12 per cent. in receipts to and from Southern railroads and steamboats. There is a decrease of 30 per cent in deliveries and about the same in receipts to and from the Toledo, Peoria & Warsaw at Gilman; a decrease of 45 per cent. in deliveries and 26 per cent. in receipts to and from the Indianapolis & St. Louis at Mattoon; a decrease of 40 per cent. in deliveries and of 30 per cent. in receipts to and from the Ohio & Mississippi at Odin, and 55 per cent. in both at Sandoval; a decrease of 17 per cent. in deliveries and 17½ per cent. in receipts to and from the Chicago, Burlington & Quincy; and a decrease of 36 per cent. in deliveries and 23 per cent. in receipts to and from the Dubuque Southwestern.

The accounts of the roads to St. Louis crossing both branches of the Central show a decrease of 10,205 passengers delivered and 4,281 received to balance the increase of 10,327 delivered and 13,849 received to and from the St. Louis, Vandalia, Terre Haute & Indianapolis road.

Many other deductions, especially interesting to passenger and ticket officers may be made from this report, which, as usual, is very full and elaborate; but we must leave these and others to those who read the report.

Validity of Municipal Subscriptions in Indiana.

It may be remembered by our readers that last summer a decision was rendered by a judge in Tippecanoe County, Indiana, denying the constitutionality of the law of that State under which counties and towns are

permitted to vote subscriptions in aid of railroads. This case was appealed to the Supreme Court of the State, and the trial was to begin this week. An immense amount is involved in the decision, for Indiana of late has voted aid to new lines almost as lavishly as Illinois did a year ago, and most of these lines remain to be constructed.

The Gilman, Clinton & Springfield Railroad.

This railroad, which was graded last year, is now being ironed. It extends, as its name indicates, from Gilman, the point of junction of the Illinois Central and the Toledo, Peoria & Warsaw roads, 81 miles south of Chicago, in a southwesterly direction to Springfield, about 115 miles, crossing the Lafayette, Bloomington & Mississippi road about 15 miles west of Paxton, the Indianapolis, Bloomington & Western about 25 miles southeast of Bloomington, and the main line of the Illinois Central at Clinton. It has an excellent country on its line, much of which will be better served by it than by any other line, and nearly all of which will find in it the most direct route to Chicago.

This railroad, when completed, is to belong to the Pennsylvania system, probably as a line leased to the Columbus, Chicago & Indiana Central, or, more directly to the new "Pennsylvania Company." It is reported that the Toledo, Peoria & Warsaw Company has lately sold to the Pennsylvania Company the right of way on its road between State Line (the terminus of a branch of Columbus, Chicago & Indiana Central) and Gilman. This will complete its connection with the Gilman & Springfield line.

The New York *Bulletin*, commenting on this reported purchase of right of way, says:

"If this rumor be true, the Pennsylvania Railroad Company has achieved a success, the value of which the New York Central Company will learn by a decrease of freight receipts on grain that will teach them to be more alert to prevent similar checkmates in future. The distance between Gilman and the Illinois State line is only twenty-four miles; but the Pennsylvania Railroad Company has a lease of the Columbus, Chicago & Indiana Central Railroad, and operated, previous to its above reported purchase, the railroad between Logansport, Ind., and the Illinois boundary. The Toledo, Peoria & Warsaw Railroad, from the Illinois State line westward, is nothing more than a continuation of the Columbus, Chicago & Indiana Central road. At Gilman—eighty miles south of Chicago—the Illinois Central crosses the track of the Toledo, Peoria & Warsaw Railroad. The purchase by the Pennsylvania Railroad Company of the 24 miles section of the Toledo, Peoria & Wabash Railroad that lies between Gilman and the State line is a good investment, for the reason that it will enable the Pennsylvania Railroad Company, through its connecting lines, to "tap," at 80 miles south of Chicago, the bulk of the eastward bound grain that the Illinois Central road brings from the country south of Gilman. This tapping will greatly lessen the amount of grain handled by the Chicago manipulators, and will also lessen the freight business of the Michigan Central, Great Western of Canada, Michigan Southern and New York Central roads. Unless this advantage can be offset in some way, the diversion of grain to Philadelphia will deprive the New York Central of a large share of its through freight business."

The *Bulletin* seems not to remember that if the Illinois Central were disposed to give up its traffic to the Pennsylvania Company at any point south of Chicago, it has already abundant opportunities. The Pennsylvania's St. Louis line crosses both the Central's lines—at Effingham and Vandalia—and the Toledo, Peoria & Warsaw has been operated entirely in harmony with the Pennsylvania, and by that there has been for some years just the same opportunity to "tap the bulk of "the eastward bound grain that the Illinois Central "road brings from the country south of Gilman," that it will have when the Pennsylvania Company shall own a line to Gilman. The error probably arose from want of knowledge of the connection to be made with the new Gilman, Clinton & Springfield road, without which the purchase of the right of way to Gilman would seem objectless.

The Chicago & Northwestern Railway.

The statements heretofore made by this company of its earnings and expenses for the current fiscal year have shown a small decrease of earnings and a very large decrease of expenses. A statement is now made for the nine months of fiscal year which expired on the 28th of February. The principal figures are as follows:

Gross earnings for nine months ending Feb. 28, 1870	$9,57[illegible],094 29
Gross earnings for nine months ending Feb. 28, 1871	9,036,178 06
Diminution in gross earnings	$533,916 23
Expenses for nine months ending Feb. 28, 1870	$6,353,284 03
Expenses for nine months ending Feb. 28, 1871	5,086,600 99
Actual reduction in operating expenses	$1,266,683 09
Diminution in gross earnings same period	533,916 23
Net increase for nine months	$732,766 86

The net earnings for the nine months reported are thus nearly $4,000,000, or not $600,000 less than the net earnings of the whole of the last fiscal year. If the decrease of earnings shall continue in the same proportion during the last quarter of the year, the total receipts of the current year will be about $11,845,000; and the expenses, if the proportion is maintained, will be about $6,400,000, leaving as net earnings $5,445,000, which is a million more than the net earnings of the previous year, an increase of 22 per cent., which, we need not say, in the face of a decrease of 5½ per cent. in earnings, will be a very remarkable result.

The Passenger Fare Bill.

The bill providing for graduated rates of fare on the Illinois railroads, which passed the lower house of the Legislature last week by a very large majority, was reported favorably by the Senate Committee on Railroads last Wednesday. This of course, is not the choice of that committee, as it originated and reported unanimously the "three-cent" bill; but it seems that Mr. Fuller and his co-adjutors prefer the House bill to nothing, which is what they are likely to have if they defeat the House bill, the House being nearly as united in support of its bill as the Senate was in passing the Fuller bill. There has been a bitter opposition to the House bill developed in the Senate, but there will hardly be votes enough to defeat it. Since Mr. Fuller has given up his favorite schemes, certainly no one else should feel unable to accept the substitute. If the bill passes, as it is likely to, its constitutionality will very probably be tested; for there are very few of our roads, we think, that will be ready to make 2½ cents per mile their minimum charge.

NEW PUBLICATIONS.

The Kansas City Bridge.—The engineers of this bridge, Mr. O. Chanute and George Morison, have prepared an elaborate monograph, giving a description of the bridge and a history of its construction, forming altogether a thin quarto volume. The construction of this bridge and especially of its piers over the uncertain and rapidly-changing bed of the Missouri River was one of the most difficult engineering works ever accomplished in this country. New obstacles were met with frequently and the ability of the engineers was taxed to the utmost to provide means for overcoming unlooked for obstacles. The work is of the utmost interest to practical engineers. We hope hereafter to give an analysis of its contents.

The Alta California Pacific Coast and Trans-Continental Railroad Guide.—This is a volume of about 300 pages like those of *Appleton's Guide*, which a description of States and Territories west of the Rocky Mountains, and all their chief towns, mining districts, hunting and fishing resorts, and the most attractive scenery, with information concerning routes, etc. It describes, also, every station on the Central and Union Pacific railroads, and statistics of trade and productions, and much other matter valuable to the traveler and immigrant. This guide begins with San Francisco and describes the stations successively thence eastward, so that it is especially suited to those traveling in this direction. It is published by Fred. MacCrellish & Co., at San Francisco, and the price is 50 cents.

Caisson for the New York Tower of the East River Bridge.

The New York caisson of the East River Bridge is slowly developing its proportions, and has now reached a stage at which it is a very interesting object to visit. It is at the yard of W. H. Webb, foot of Sixth street, East River. The timber work—which has now reached the eleventh course, or two feet above the roof of the air-chamber—is constructed by the contractors, Messrs. Webb and Bell, who built the Brooklyn caisson. The iron-work, which is nearly completed, has been done by Messrs. Roach & Son, of the Morgan Iron Works.

The experience gained in sinking the Brooklyn caisson has led to several modifications in the plan for the new one. The length has been increased four feet, making the size at the base 102 by 172 feet. A person entering the yard at present, and looking at one corner of the caisson, sees on the stocks two walls of timber eleven and a half feet high, sloping slightly inward from bottom to top, and stretching away on either hand to the distances named. Entering further, and pausing directly under one of the walls, it is found to be but eight inches thick at the bottom, but sloping inward rapidly, so that at nine feet high it is eight feet thick. Above this the courses of timber all pass entirely across from wall to wall; thus covering over a rectangular space called the air chamber, in which, by day and night, busy toilers will work for months far beneath the bed of the river.

Climbing to the interior it is found to be divided by other walls of timber into six chambers, each about one hundred feet by twenty-eight feet, with doorways between. These division walls will eventually be made four feet in thickness.

The next noticeable feature is that the whole interior surface of the air-chamber is covered with boiler iron. This immense sheet has been built up of smaller sheets in sections, which are joined together by light angle irons at the edges. By this means provision is made for the effect of heat and cold, which will produce a total change in the length of the lining of nearly two inches. The object of the lining is two-fold. First, to secure absolute protection against fire; and, second, to prevent the compressed air from escaping through the seams between the timbers. In the Brooklyn caisson these seams were all caulked, but in this only a few will be.

The danger from fire increases rapidly as the depth increases, even woollen clothing taking fire easily at a depth of eighty feet. This is due to the greater quantity of oxygen brought in contact with a flame when it is once started than would be in air of ordinary density.

The danger of a timber structure is much greater also in consequence of the enormous draft caused by the escape of air at a pressure of forty pounds through any small crevice. This was the difficulty experienced in extinguishing the fire in the roof of the Brooklyn caisson. The pressure of air was about eighteen pounds per square inch, and it carried the flame with a furious blast, twisting about wherever it could find the least escape. In this way, although no large amount of timber was burned, yet the fire ramified in thin and narrow streaks to distances of twenty feet from the point of starting, and no stream of water could possibly reach it.

This lining contains about eighty-five tons of iron, and is held up on the V or side walls by heavy bars of iron, with long bolts running through them and through the V. It will be fastened to the roof by bolts, at distances of two feet in each direction. These will pass through three to five feet of timber, and serve the additional purpose of binding the roof timbers firmly together

Other bolts, twelve feet long, hold the partition walls and roof together; and in addition to all these, an immense number of screw-bolts and shorter "drift" bolts are used; so that about 300,000 pounds of iron bars are used in the structure.

A complete system of water-pipes is to be introduced, so that a large stream of water can be delivered at any point in the caisson.

Clambering about underneath the roof, a number of large holes through the iron lining will be seen. These are for the iron pipes of the sand pumps, through which the sand excavated will be pumped to the surface above. Powerful rotary pumps will be attached to their upper ends, and a constant supply of sand and water kept up at the lower end. By giving the pumps a rapid motion the water will carry up with it a very large amount of sand; and it is expected that the excavation can be made quite as rapidly as it will be possible to lay the masonry above.

The preliminary borings at the place where the caisson is to be sunk, show that at a depth of 70 feet, and from there to the bed rock, which is at 80 to 82 feet deep, the sand contains a large number of boulders. For the removal of these it was necessary to provide water-shafts and dredges, similar to those in the Brooklyn caisson.

The water shafts in this are made cylindrical, two in number, and are about eight feet in diameter. They will not be used except to remove boulders, or such other material as will not pass through the sand pumps.

The next thing that attracts attention in the search are the cylinders of the air-locks. In this caisson these are placed partly within the air-chamber, and project up four feet into the timber. They are in two pairs, each pair joined together by a rectangular trough of iron. If we go now to the top of the caisson and look down into the trough, a door will be seen at each end, opening into one of the cylinders. Going through one of these, into the cylinder or lock, there is seen another similar door lower down and opposite the first, through which we may pass again to the interior of the caisson.

Each of these cylinders is a complete air-lock in itself, and serves to pass the operatives from the natural pressure of the atmosphere to the increased pressure in the air chamber of the caisson. As each cylinder will hold about twenty men comfortably, eighty men can be passed in or out every five minutes.

Surmounting each pair of air-locks is a large iron cylinder, which serves as the bottom of the well-hole by which to reach them. This will be joined above to a wooden curb, which will be carried up and kept water-tight, as the caisson descends. A circular staircase will be built in this by which to ascend and descend.

The supply shafts will be four in number, instead of two, as on the Brooklyn side.

The work of laying the timber is progressing rapidly, and it is hoped to launch the caisson by the 15th of May.—*New York Evening Post.*

Chicago Railroad News.

Lake Shore & Michigan Southern.

The annual meeting of this company for the election of directors will be held in Cleveland on the 3d day of May next. The transfer books will be closed on the 3d of April, and opened next the day after the meeting.

Chicago & Northwestern.

The company has just completed its new entrance into Madison, which extends from Syene about three miles northward, crossing Third Lake, into the city.

Mr. George L. Dunlap, the General Manager, is making a journey to California.

Michigan Central.

Passengers for Lafayette, Indianapolis, Louisville, Cincinnati, etc., now take the 9:00 o'clock a. m. New York express, instead of the 9:30 Cincinnati train, which has been discontinued. Close connections are made at Michigan City.

A through car for Grand Rapids will run in connection with the 5:15 p. m. Atlantic express *every Sunday*, the 9:00 p. m. train to which it is attached on week days not running on Sunday.

General Railroad News.

OLD AND NEW ROADS.

Knox & Lincoln.

The rails are laid as far as Wiscasset, to which place the road will soon be opened for business, and it is expected that trains will be running to Damariscatta, about 30 miles northeast of Bath, by June.

Morris Canal.

The Morris Canal Company has contracted to lease its canal, boats and other property for 999 years to the Lehigh Valley Railroad Company. Ten per cent. per annum is to be paid on its preferred stock, and 4 per cent. on its consolidated stock, and the railroad company is to assume the mortgage debt of the canal company, amounting altogether to $785,000 in 6 per cents., and $340,129 in 7 per cents., and also to pay the riparian tax of $25,000 per year. This lease will be submitted to the stockholders of the canal company on the 3d inst., and as the terms are considered quite liberal, it is probable that they will confirm it. This canal extends from Phillipsburg, on the Delaware, opposite Easton, across the State of New Jersey, to Jersey City, and is 102 miles long. It is employed almost exclusively in carrying anthracite coal to New York.

Lena & Dakota.

It is proposed to construct a branch of the Western Union Railroad from Dakota, a station eight miles northeast of Freeport, due west fifteen miles to Lena, which is a station on the Illinois Central thirteen miles northwest of Freeport. It would be close to other lines throughout its length, but it is thought that it might attract a considerable amount of business from the Illinois Central.

Detroit, Howell & Lansing.

An agreement to consolidate this company and the Ionia & Lansing Railroad Company has been made by the directors of the two companies, and was to have been voted upon by the stockholders on the 30th ult. There is scarcely a doubt that the consolidation will be ratified. Grading is now progressing rapidly at several points between Detroit and Lansing, the iron is at Buffalo, and tracklaying is to be commenced very soon after the opening of navigation.

Leavenworth, Lawrence & Galveston.

Mr. Walker, President of the company, in a correspondence dated March 16, said "the right of way has been secured for a railroad bridge across the Kansas River at Lawrence for the Leavenworth, Lawrence & Galveston Railroad, and surveys have been made and plans prepared for the same; that said bridge will be completed before the first day of January, 1872, and the track of that road connected with the track of the Kansas Pacific Railway; also, that arrangements have been made between the officers of the latter road and myself by which through freight and passenger cars will run permanently from the city of Leavenworth to the south side of the State of Kansas, without change or break of bulk, as soon as the bridge at Lawrence can be built, and the road completed to the southern boundary of the State."

Pennsylvania Railroad.

The Western Market Company of Philadelphia have sold their market house, on the northeast corner of Seventeenth and Market streets, to the Pennsylvania Railroad Company, to be used as a freight depot, possession to be given next fall. It is also proposed to enlarge the depot occupied by the Philadelphia & Erie Railroad. Negotiations are in progress for the purchase of the remaining property on the block bounded by Fifteenth and Sixteenth, Market and Filbert streets, when the entire block will be occupied by the depots.

Cincinnati Southern.

The engineers have completed the surveys of the different routes contemplated and are now making the profiles. The Cincinnati *Gazette* gives the following general courses of the surveys made:

"The first survey was made from Walton to Lexington, across the highlands, following closely the turnpike road to Lexington, by which about twenty miles will be saved over the route by the Kentucky Central.

"The second survey left the route of the Central at Paris, passing through Winchester and Richmond, to the Lebanon Branch road from the Louisville & Nashville Railroad, near Rockcastle River, east of Mount Vernon.

"The third line runs from Georgetown, a point on the first survey, through Versailles to Danville.

"The fourth survey was from Nicholasville to Somerset, six miles from the Cumberland River, *via* Lancaster.

"The sixth commenced near South Danville, passed through Monticello, in Wayne County, one of the southern tier of counties, and continued thence to Jamestown in Fentress County, in Tennessee, which adjoins the Kentucky line. Thence it continued by White's Creek, to the Tennessee Valley until intersecting the route surveyed by Col. Gaw northwardly from Chattanooga, which route is followed to the southern terminus of the road.

"The seventh survey was a revision of the old military or Burnside survey from Somerset, Pulaski County, Kentucky, *via* Emory River to the Valley of the Tennessee, a route concerning which much was said at the time of the location of the southern terminus of the Cincinnati Southern Railroad. After reaching the Tennessee Valley the route followed the survey of Col. Gaw to Chattanooga.

"In connection with this line a survey was made for a connection with the Knoxville Branch.

"The eighth route commences on the sixth survey on the White's Creek part, the point of departure being a few miles north of Crossville, Tenn. Thence from the highlands the route descends to the rich valley of the Sequatchie River, which pursues the Tennessee River.

"It will thus be seen that, in addition to the several distinct lines surveyed through the State of Kentucky, four lines have been run through the State of Tennessee, two lines passing directly through the latter State, and the other two being made of parts of those lines connected by additional surveys.

"It, however, should be stated that still another survey was made from Danville, Kentucky, to Sparta, White County, in Central Tennessee, where connections would be made with the road running northwardly from McMinnville by which name the route is known.

"In addition to these they have in their possession what is known as the Childs survey, from the vicinity of Harrodsburg, Kentucky, by way of Lebanon and Glasgow to Nashville.

"By the direct routes, the distance from Cincinnati to Chattanooga is about three hundred and sixty-five miles, by which it will be seen that express through trains may run from this city to Chattanooga in a little more than ten hours, and to Atlanta, Georgia, within the hours of daylight during the long days of summer."

New York & Harlem.

A special meeting of the stockholders of the New York & Harlem Railroad Company, for the purpose of acting upon the proposed increase of the capital stock, by the amount of $2,000,000, will be held at their office in New York on the 11th inst.

Lawrence & Pleasant Hill.

The length of this line is 61 miles. Of the eighteen miles between Lawrence and DeSoto, Ks., thirteen miles are graded. From Pleasant Hill, Mo., westward eight miles are graded. The grading is to be completed from Pleasant Hill to Olathe, Ks., 33 miles, by the middle of June, and the track laid by the 1st of October.

Memphis & Selma.

On the 25th ult. the city of Memphis voted, by a majority of twelve to one in favor of a subscription of $500,000 by the county in aid of the Selma & Memphis Railroad. The country towns in the county voted almost unanimously against the subscription, but could not overcome the heavy majority in the city. The Alabama portion of this road, we believe, is pretty well provided for and partly completed.

The different organizations for building this line in Tennessee, Mississippi and Alabama were consolidated lately at Selma, and a new board of directors, with General Forrest as President, was elected. Fifty miles of the road, from Selma toward Columbus, is now in operation. The contracts for building the road from Memphis to Holly Springs are to be let with the provision that they are to be completed within twelve months.

St. Louis & Southeastern.

The grading is nearly completed from Evansville, Ind., to the Wabash River.

Indianapolis, Cincinnati & Lafayette.

Application was made to the Common Pleas Court of Cincinnati, on the 28th ult., by a judgment creditor of the Indianapolis, Cincinnati & Lafayette Railroad Company, for reversion of the order by which General Morris and William T. Boaz, and subsequently M. E. Ingalls, were appointed receivers of that road, on the ground that they were stockholders and creditors of the road.

The Canada Canals.

The report of the Canal Commissioners of the Dominion of Canada, as presented to Parliament, recommends uniformity in the St. Lawrence canals, and the construction or improvement of canals which will require appropriations as follows: Sault Ste. Marie, $550,000; Welland Canal, $6,550,000; Lower Ottawa, $1,800,000; Chambly, $1,500,000; deepening of the St. Lawrence, between Quebec and Montreal, $880,000; Bay Verte Canal, $3,250,000; St. Lawrence Canal, $4,500,000; Upper St. Lawrence River, $220,000.

Chicago & Iowa.

Engineers are surveying a line for this road between Forreston, on the Illinois Central, and Lanark, on the Western Union.

Meridian, Red River & Texas.

The Jackson (Miss.) *Pilot*, of March 23, says: "The organization of the Meridian, Red River & Texas Railroad Company was completed last night at the Edwards' House, by the election of the following officers: President, G. W. Cochran; Treasurer, Louis Trager; Secretary, T. H. Whipple. Proper by-laws and regulations were also adopted, and the capital stock placed at $5,000,000. It is expected that books for subscriptions to the stock will soon be opened in this and other principal cities, and that, in accordance with the provisions of the charter, an opportunity for counties to subscribe will also be given. The terminus of this road in Mississippi is to be at Riverside, in Wilkinson County. It will form, with its Louisiana and its other connections, the nearest and most direct route to Texas and the Pacific coast."

Plattsburg & Whitehall.

This company has been at work on a bridge across Lake Champlain opposite Ticonderoga, having found the country on the New York side of the lake too difficult. It was claimed that the bridge on the New York side was being made so as to be a serious obstruction to navigation, contrary to the law. The subject was brought up in the New York Legislature and referred to the Canal Commissioners and State Engineer. These unanimously report that the company have violated the laws of the State in obstructing the channel and advise that the law be repealed by which the company claims the authority to build such a bridge.

Missouri, Kansas & Texas.

The survey of the line in Texas is completed from Preston, on Red River, where the line leaves the Indian Territory, to Austin, crossing the Brazos River at Waco.

Green Bay & Lake Pepin.

Concerning this road the Green Bay *Advocate* of the 23d ult. says: "We have the best possible news from "the negotiations now going on in New York in regard "to iron and rolling stock. The iron for the finished "grade of forty miles between here and New London "will be here on the opening of navigation, and the "negotiations which have for some time been pending "for the iron and rolling stock for the entire line to the "Mississippi, are delayed in their final consummation "only by some comparatively trivial obstacles, which "will soon be removed."

Memphis & Little Rock.

This railroad, which has been dragging its slow length along (swimming part of the time) ever since the war, was completed last week as far west as the White River. The section west of the White River has been in operation for years, and the completion of the bridge over that stream is all that is necessary to enable trains to run through between Memphis and Little Rock. This bridge is to be completed very soon, probably by the end of next week. This road is of the greatest importance to both cities at its termini, giving Little Rock its sole railroad outlet, and forming the only feeder to Memphis from the West. It will give an outlet to the Little Rock & Fort Smith Railroad, a large part of which is completed, and the remainder progressing rapidly.

Cincinnati & Indianapolis Junction.

The machine and car shops of this company are to be removed from Cambridge, Ind., to Indianapolis within three months.

Cincinnati & Mackinaw.

W. A. Weston, Receiver of this company, advertises that he will sell at auction, at Greenville, Darke County, O., on the 6th day of May next, the road-bed and right of way, and the various structures belonging to this line, beginning near Greenville and extending northward to Van Wert, a distance of 55 miles. The value of the property thus offered for sale is appraised at $17,000. We understand that an effort will be made to revive this project and secure the construction of the road.

Newark, Somerset & Straitsville.

This company, which has been in existence a long time, but not very active, has completed its road from Newark, O., southeastward to Somerset, a distance of 24 miles, and has sufficient means to grade the rest of the line to the coal-fields of Straitsville. J. S. Birkey, of Newark, is the Managing Director.

The Erie and the Ohio & Mississippi.

In the United States Circuit Court of New York, a bill in equity has been filed by the Erie Railway Company against the Ohio & Mississippi Railroad Company.

The bill alleges that by the laws of the States of New York, Ohio, and Pennsylvania the plaintiff is authorized to lease, and has leased, the Atlantic & Great Great Western Railway, and the road extending from Dayton to Cincinnati, known as the Cincinnati, Hamilton & Dayton Railroad, and connecting with the Ohio & Mississippi Railroad at Cincinnati; that the track of both these roads is broad gauge; that the defendants resolved to change the gauge of their road from the broad to the narrow gauge, and purchased twenty locomotives and a large number of cars to run on such a gauge; that negotiations were entered into between the plaintiff and the defendants, in the course of which the latter agreed to abandon the design of changing the gauge of their road on condition that the plaintiff would buy from them their narrow-gauge locomotives and cars for $300,000, and would transport free of charge over its road a large amount of railroad iron for the use of the defendants; that a written contract was made to this effect; that the plaintiff bought the cars and locomotives at the stipulated price, and transported the iron as agreed, at an expense of about $60,000; that the plaintiff believes that the defendants are about to repudiate this contract, change the gauge of their road, and enter into an alliance with the Baltimore & Ohio Railroad. Upon these representations the bill prays for an injunction restraining the defendants from changing the gauge of their road.

Memphis & Raleigh Springs.

This road is projected to run from Memphis, north of east 8¾ miles, to Raleigh Springs. Two surveys of the line have been made during the past year, and the definite location made. The Chief Engineer, Mr. Thos. H. Millington, in his annual report, recommends a gauge of 3 feet 6 inches. It is expected to have the road completed and running by the first of July next. Sealed proposals for building the road were to have been opened last Saturday.

Jacksonville, Pensacola & Mobile.

Proposals will be received at the office of this company in Tallahassee, Fla., until the 3d inst., for the grading, bridges and ties of an extension of this railroad from the Apalachicola, a river near Chattahoochee, westward to the Choctawhatchee River, 65 miles, and also of the section west of the Choctawhatchee, and extending to a junction with the Pensacola & Louisville Railroad, also 65 miles long. At the same time bids will be received for a section 26 miles long of a branch line from Quincy (20 miles east of the Apalachicola) north to Bainbridge, Ga. There will be three large bridges on the main line, one over the Chattahoochee, one over the Chipola, and one over the Choctawhatchee. The line is through a high, rolling country, which is very healthy. Profiles and specifications can be seen at the office of James G. Gibbs, Chief Engineer, Quincy, Fla.

Detroit, Lansing & Lake Michigan.

Under this name it is proposed to construct an extension of the Lansing & Ionia Railroad (now consolidated with the Detroit, Howell & Lansing) from its present terminus at Greenville in a westerly direction to Muskegon, forming a line parallel with the Detroit & Milwaukee and twelve or fifteen miles north of it. The Detroit *Tribune* says that Mr. Joy has proposed to the citizens of Muskegon to undertake this extension if they will raise $100,000 in aid of it. It would be about 60 miles long, and would give Muskegon a through and very direct connection with Detroit, though very little better than that which it now has, which also is controlled by Mr. Joy.

Buffalo & Washington.

The road is completed and in operation to Holland, and so nearly completed beyond to Arcade that it was anticipated trains would reach that place to-day. Additions are making to the rolling stock. A new locomotive, the "Sardinia," was last week received from the Baldwin Locomotive Works, and another one is now buiding for the company at the same works.

International.

The contracting firm of Douglas, Brown, Reynolds & Co., are now at work fulfilling their contract on this Texas road, which is to run from the Rio Grande River northeast to a connection with the Cairo & Fulton Railroad in Arkansas. The Rock Island *Union* learns from Mr. Saulpaugh, a member of the contracting firm, that about forty miles of the road in the vicinity of Herne, on the Houston & Texas Central, was to be completed by the first of April.

Louisville, New Albany & St. Louis Air Line.

This company has ten miles of road completed and in operation, from Princeton, Ind., to the Wabash River at Mount Carmel. The first annual report states that the one hundred and two miles, from Princeton to New Albany, on which some very heavy work is met, is under contract to be completed before 1873. The road, when completed, will be operated by the St. Louis & Southeastern Company, connecting with one division of their road, yet to be built, from Mt. Vernon, Ill., to Mt. Carmel.

Atchison, Topeka & Santa Fe.

The Augusta *Crescent* says the Atchison, Topeka & Santa Fe Railroad have filed at the United States Land Office at that place a plat of the definite location of their road to near Wichita, thence westward up the Arkansas River to range 19 west.

Ottawa, Oswego & Fox River Valley.

The part of this line between West Aurora and Geneva, was left unfinished when winter set in, though graded. Now the track is down on nearly the entire section, which is ten miles long, and construction trains run from Aurora to Batavia, seven miles. When completed the Chicago, Burlington & Quincy will have two lines between Aurora and Batavia, one (the old one) on the east side of Fox River and the other on the west.

Portland, Saco & Portsmouth.

The stockholders met lately and accepted propositions for the lease of their road to the Eastern Railroad Company. The terms of the lease accepted, provide that the Eastern Railroad Company assume all liabilities of the Portland Company, and the payment annually to the latter company of 10 per cent. on its capital, semi-annual payments of 5 per cent. for duration of the lease which is ninety-nine years.

Evansville, Henderson & Nashville.

The following table gives the stations and their distances from Evansville, on this recently completed road:

Evansville (by ferry) to—		Elizabethtown & Railroad Crossing	Paducah 61.8
Henderson	12.	Petersburg	66.8
Alves	18.2	Crofton	72.6
Busby's	21.2	Underwood's	74.8
Robards	24.4	Hopkinsville	85.9
Sebree City	29.3	Casky	9 .3
Dixon road	32.5	Pembroke	96.3
Slaughtersville	39.2	Trenton	102 3
Hanson	43.9	Moore's	106.4
Madisonville	50 5	Guthrie	110.4
Earlington	54.8	Nashville	157.0
Morton's	58.3		

Of these, Alves, Dixon, Railroad Crossing, Underwood's, Casky, and Moore's are flag stations.

St. Louis & Southeastern.

At a late meeting of the Board of Directors, resolutions were adopted authorizing the issue of $1,000,000 first mortgage bonds on the Evansville Division of the road, being at the rate of $1,500 per mile; placing the common and preferred stock upon an equal basis, after eight per cent. dividends have been paid on each; conferring upon the President free power and authority to proceed with the construction of the road, and to that end, do and perform such acts as may be requisite for the purpose named; adopting a seal; authorizing the President to apply for and receive all subscriptions in Indiana, and to issue stock for the same.

ELECTIONS AND APPOINTMENTS.

—William S. Towne has resigned his position as Master of Car Repairs of the Hudson River Railroad, and John W. McKenna, late foreman, has been appointto fill the vacancy.

—On the 27th ult. Hudson E. Bridges, Joseph Brown, N. C. Chapman and Andrew Pierce were chosen directors of the Missouri Pacific Railroad Company. All except Bridges are new members of the directory. Mr. Pierce is Managing Director of the Atlantic and Pacific Company. Joseph Brown was chosen President of the company, and Hudson E. Bridges, late President was chosen Vice-President.

—The following is a corrected list of the officers of the Cincinnati & Indianapolis Junction Railroad since the recent changes: President, L. Worthington, Cincinnati; Auditor, W. C. Tremain, Cincinnati; Treasurer, J. Walters, Cincinnati; General Superintendent, E. L. Wertz, Indianapolis; Superintendent of Telegraph, O. M. Shepard, Indianapolis; Gengeral Freight Agent, W. C. Lynn, Indianapolis; General Traveling Agent, J. M. Ridenour, Indianapolis.

—At a recent meeting of the old Cincinnati & Dayton Short Line Railroad Company, 6,000 shares were voted, and A. J. Hodder was chosen President, R. Beresford, Treasurer, and G. B. Ellard, Secretary.

—The following were chosen directors of the New Orleans, Mobile & Chattanooga Railroad Company at the annual meeting in New York on the 14th ult.: James A. Raynor, William L. Williams, Edwin D. Morgan, John A. Griswold, Oakes Ames, Thomas W. Pierce, Peter Butler, George Jarvis, William M. Tweed, James H. Banker, Harrison Durkee, John Stewart, Louis A. Von Hoffman, Levi P. Morton and Joseph Seligman. James A. Raynor was re-elected President, Harrison Durkee was chosen Treasurer, John G. Howell re-elected Secretary. The Executive Committee are Oakes Ames, E. D. Morgan, James H. Banker, Harrison Durkee, John Stewart, L. P. Morton, John A. Griswold and Wm. S. Williams.

—The stockholders of the Lake Shore & Tuscarawas Valley Railroad Company organized at Cleveland last week by the election of the following directors: Selah Chamberlin, Cleveland; Hon. W. S. Streater, East Cleveland; R. R. Herrick, Cleveland; J. F. Card, Cleveland; E. G. Loomis, Wadsworth; Clement Russell, Massillon; Edwin Bayless, Massillon; Thos. Moore, New Philadelphia; Thomas W. Chapman, Navarre: James Mason, Cleveland; Simpson Harment, Canal Dover.

—The following directors of the Memphis & Selma Railroad were lately elected, at Selma, Alabama: John C. Fizer and Jacob Thompson, Tennessee; S. M. Meek, of Columbus; W. W. Throop, of Monroe County, and R. H. Murdock, of Okolona, Mississippi: Allen Jones, of Greensboro; C. C. Huckabee, of Marion; A. G. Mabrey, of Selma, and Robert Crawford, of Eutaw, Alabama. After which, the following officers were elected: President, N. B. Forrest; Treasurer and Secretary, S. H. Foulkes; Chief Engineer and Superintendent, Peter Fresenius. Jacob Thompson was elected Chairman of the Executive and Financial Committee.

—Mr. E. F. Babcock, President of the Memphis & Raleigh Springs Railroad, resigned his office on the 23d of March, and Judge J. T. Swayne was elected to fill the vacancy.

—Mr. E. C. Brown, formerly Train Dispatcher and more lately General Agent of the Milwaukee Division of the Chicago & Northwestern Railway, has been appointed Master of Transportation of the Burlington & Missouri River Railroad, with headquarters at Ottumwa.

—Hugh Pitcairn, late Assistant Superintendent of the Evansville, Henderson & Nashville Railroad, has been appointed General Superintendent to succeed Colonel H. L. Shepherd, resigned.

MECHANICS AND ENGINEERING.

Improved Rotary Engine.

Mr. Wm. P. Vickery, of East Auburn, Maine, has invented an improved rotary steam engine, for which he received a patent October 18, 1870. It is described as follows:

It has within a circular casing two solid wheels separated by a partition. The circular casing is enough larger than the wheels to form an annular chamber to receive pistons fitting the same. Upon the top of the casing are placed the valve seats, and through these are the ports through which enters the steam. Each wheel has its own inlet port and valve. Drop valves compel the steam to work only on one side of the pistons. The drop valves are raised when the pistons pass by means of inclined surfaces on one or both sides of the pistons, according as the engine is designed to move in one or both directions, but are pushed down again by springs. The drop valves are between the exhaust and inlet ports, so as to be raised after the steam has been exhaused and before it is again admitted. The valve stems are attached to rocking shafts, which are pivoted to suitable supports. These shafts are pivoted to a cam set on the shaft of the two solid wheels of the engine, and so operate as to open and close the valves as required to admit and let off the steam.

Mr. Vickery has made some experiments with a model of this engine which have satisfied him that it will be remarkably economical and powerful. He may be addressed as above.

King Iron Bridge Manufacturing Co.

The Company has commenced building extensive shops at Iola, Kansas. The buildings are all of stone. Four bridges are already ordered that will be built at the Iola Works, and it is, we believe, intended to fill all orders west of the Mississippi at these shops.

Narrow Gauge in Tennessee.

Mr. Thomas H. Millington, Chief Engineer of the Memphis & Raleigh Springs Railroad, a suburban road from Memphis north of east 8¾ miles to Raleigh Springs, in his late annual report recommends a gauge of 3 feet 6 inches.

"The economy of the construction and the cheapness of operating light, narrow-gauge railroads admirably adapt them for just such localities and traffic as your road will occupy and have to perform. Still, in my opinion, the gauge should to some extent be controlled by the nature and amount of traffic the road may have to accommodate, and although your road may carry a considerable quantity of freight, it will be most useful and pay best as a passenger road; and should it be constructed and equipped with this object in view, I therefore would not advise you to adopt a narrower gauge than three feet six inches. The cost of constructing a road with three feet six inch gauge does not exceed that of a road with two feet nine inch gauge more than about four hundred dollars per mile, while

the greater steadiness, safety and superior facilities for convenient passenger cars on the three feet six inch gauge are greatly in favor of its adoption on your road. The following estimate is for a light T rail, weighing twenty-five pounds per yard, with suitable joint fastenings, laid on cross ties 7x5, and six feet long, placed twelve inches apart in the track. The equipment is light, but is considered enough to commence with, as it can be increased at any time the business of the road may require it.

"All materials used in construction will be of the best quality, and the workmanship plain and substantial."

ESTIMATE OF COST.

Grubbing and clearing	$1,100 00
Earth excavating	16,200 00
Pile bridging	3,000 00
Piling or trestling	2,400 00
Hog culverts and cattle guards	1,000 00
Road crossing and farm roads	300 00
Cross ties delivered	6,200 00
Laying track	3,000 00
	$33,200 00
Engineering, cost of surveys, right of way, printing and stationery, advertising, office expenses, contingencies, etc	$3,329 60
Road bed complete	36,520 00
Tons iron rails	29 410 00
Pounds spikes	1,210 00
Chains or joint fastenings	4,500 00
Superstructure	$35,130 00
Two engines, delivered, $6,000	12,0 0 00
Four passenger cars, delivered, $1,200	4,800 00
Eight baggage and freight cars, delivered, $900	7,200 00
One hand car	150 00
Two water tanks and wood sheds	600 00
Depots, platforms and temporary buildings, tools, etc	2,500 00
Equipment	$27,250 00

RECAPITULATION.

For road bed, track laying and engineering	$36,520 00
For superstructure	35,120 00
For equipment and buildings	27,250 00
Total	$98,890 00
Cost per mile	$11,301 71

Light Locomotives.

The Smith & Porter Locomotive Works, which were recently burned in Pittsburgh, are to be rebuilt immediately by the new firm of Porter, Bell & Co., composed of Mr. Porter, of the old firm; A. W. Bell, late of the Pittsburgh Forge & Iron Company, and H. N. Sprague, who was in charge of the late iron works for two years, and has served in the machinery department of the Cleveland & Pittsburgh and the Atlantic & Great Western roads. This firm will make a specialty of light locomotives, for which there is likely to be an increasing demand in the West as well as in Pennsylvania.

British Rail Exports in 1871.

Heyerdahl, Schonberg & Co., of No. 32 Pine street, New York, make the following monthly report of exports of railway iron from Great Britain, extracted from government returns:

	Month ending 28th February.			Two months ending 28th February.		
	1869. Tons.	1870. Tons.	1871. Tons.	1869. Tons.	1870. Tons.	1871. Tons.
United States	21,939	32,937	32,784	42,360	57,567	61,048
Russia	1,283	65	2,951	1,283	973	3,144
Austrian Territories	2,695	1,611	47	6,436	6,611	129
British India	6,0 6	19,890	6,363	7,678	40,9 0	10,758
British North America	1,113	750	....	1,223	750	109
Egypt	....	1	2 0	....	5 3	200
Australia	3,333	941	1,129	5,045	2,090	2,238
Brazil	3 3	895	723	391	1,060	2,706
Holland	749	421	47	1,560	1,862	47
Spain and Canaries	380	2,149	545	911	4,579	1,426
Sweden	....	....	....	....	....	....
Chili	1,041	1,425	17	1,658	4,089	25
Spanish West India Isl'ds	....	4	....	319	525	15
Peru	3,337	2,110	191	5,612	2,89	408
France	39	50	20	1,071	91	20
Germany	224	1,757	505	716	4,367	533
Other countries	1,499	8,313	6,7 0	4,176	13,104	9,9 3
Total	44,009	73,369	52.223	80,139	142,021	92,795
Total exports from Great Britain of iron and steel to all countries	147,376	178,754	137,397	280,966	351,304	219.181

British Rail Exports—1870.

Heyerdahl, Schonberg & Co., make the following monthly report of exports of railroad iron from Great Britain extracted from government returns:

	Month ending 31st December.			12 Mos. ending 31st December.		
	1868. Tons.	1869. Tons.	1870. Tons.	1868. Tons.	1869. Tons.	1870. Tons.
United States	19,905	22,681	5 ,600	268,000	299,196	421,788
Russia	....	1,783	364	101,290	246,162	286 821
Illyria, Croatia and Dalmatia	....	1,319	11	10,498	27,020	36,366
British India	3,936	11,740	6,716	6 ,168	99,224	158,139
British North America	....	....	849	16,368	23,792	36,344
Egypt	....	....	62	10,515	6,276	2,239
Austria	1,840	1,568	628	12,281	23,329	8,682
Brazil	1,852	371	1,095	5,200	3 97	5 888
Holland	2,046	706	370	25,782	12 184	15,795
Spain and Canaries	1,645	999	1,214	11,017	13 4 3	13,197
Sweden	45	....	251	1,673	5,223	2,932
Chili	623	1,94-	1,438	3,228	4,823	16,913
Cuba	49	....	510	2,739	1,376	3.709
Peru	1,051	72	163	5,451	21,841	13,843
France	30	143	....	221	4 461	362
Prussia	295	2,491	2,387	7,225	23,910	47,104
Other Countries	3,203	4,533	8,531	31,812	7 ,743	75,036
Total	36,520	50,944	75,174	583,488	888,010	1060123
Pig and puddled iron to all countries	37,613	52,158	43,142	552,999	710,656	752,681

True Surface Plate.

A correspondent of the *English Mechanic* says: "It is impossible to get up a surface plate without a true one to work from. Whitworth's pamphlet on 'Plain Metallic Surfaces,' is the most perfect mode, as follows: Take three plates of cast-iron, of equal size and proportionate strength; the metal should be of hard quality. The plates should have three projecting pieces on backs placed triangularly in the most favorable positions for bearings on planing machine table. When planed, select one as the model, and let others be surfaced to it, with the aid of coloring matter. For distinctness they may be called Nos. 1, 2, 3. When 2 and 3 have been brought up to No. 1, compare them together. It is evident that if No. 1 be in any degree out of truth, Nos. 2 and 3 will be either both concave or both convex, and the error will become sensible on comparing them together. When Nos. 2 and 3 are found to agree, the next step is to get up No. 1 to both, so as to compare the impressions. As No. 1 is now nearer the truth than either of the others, it is again taken as the model, and the operation is repeated. It will be observed the process now described includes three parts, and consists in getting up the surfaces to one another in the following order: 1st, Nos. 2 and 3 to No. 1; 2d, Nos. 2 and 3 to each other; 3d, No. 1 to 2 and 3. By this process he can have perfectly true surface-plates, to be finished entirely with the scraper."

St. Joseph Bridge.

Col. E. D. Mason, Chief Engineer of the St. Joseph Bridge Company, has submitted his report of the survey lately completed, together with an estimate of the cost of the bridge. A summary of his report taken from a local paper is as follows:

"At low-water the channel opposite the city is from 400 to 500 feet wide and from 15 to 30 feet deep. The difference of level between extreme high and low water is found to be twenty-three feet. Rock is found at an average depth of forty-three feet below low water, and at no point deeper than forty-eight feet.

"The bed of the river is fine sand on top, with layers of clay or mud and coarser sand near the bed-rock. The Kansas shore is alluvial in alternate layers of fine sand and silt, of small specific gravity, and very easily moved by an impinging current, but the Missouri shore is of much more durable material. The sand in the bed of the river is almost as easily moved by running water as is the material composing the Kansas shore, and trifling obstructions to the current are sometimes the beginning of important changes in the direction and depth of the channel, making a rapid river with its bottom but a few feet above the rock where a few days before was dry land at ordinary high water.

"With these facts in view, any bridge across the Missouri River, at St. Joseph, to be considered permanent, must be built upon the hypothesis that the river is at flood, the whole width from bank to bank, its channel bed on the rock, and the current running at its swiftest speed.

"His estimates of cost are for an iron bridge of the most approved pattern with first-class masonry substructure.

Superstructure	$280,000
Substructure	435,000
Riprap for protecting banks in the immediate vicinity of abutments	20,000
East approaches complete	10,000
West " "	20,000
Total	$765,000

TRAFFIC AND EARNINGS.

—The traffic receipts of the Grand Trunk of Canada for the week ending March 4 amounted to £31,700 against £24,500 in the corresponding week of last year, showing an increase of £7,200, or 29½ per cent.

—The traffic receipts of the Great Western of Canada for the week ending March 3 amounted to £18,397 against £16,483 in the corresponding week of last year, showing an increase of £1,914, or 11½ per cent.

—The earnings of the Jeffersonville, Madison & Indianapolis Railroad for the past three years were: 1868, $1,063,523.73; 1869, $1,140,099.58; 1870, $1,217,-233.44. This shows an increase of over $76,000 each year, or 7 1-5 per cent. in 1869, and 6¾ per cent in 1870.

—A correspondent of the St. Louis *Democrat*, writing from Austin, Texas, says that it is estimated there that about 900,000 head of cattle will be driven from that State this season, 500,000 to Abilene and 400,000 to other points.

PERSONAL.

—Gen. William Mahone, President of the Atlantic, Mississippi & Ohio Railroad Company, (Norfolk to Bristol), was bitterly opposed to the sale of the Richmond & Petersburg Railroad, lately authorized by the Virginia Legislature, and he and John M. Lyon, an attorney for the parties, who secured the legislation, came to blows in the streets of Richmond, and General Mahone's pistol was discharged in the course of the quarrel.

—We learn that Col. H. L. Shepherd has resigned his position as General Superintendent of the Evansville, Henderson & Nashville Railroad. Mr. Shepherd went to the road when it was but half finished and promised little for the future. While he was operating it the road has grown to completion and now promises fair to become an important through route. A newspaper published at Hopkinsville, Ky., where Colonel Shepherd has resided, says: "We are assured by competent authority that Colonel Shepherd's official course has met the commendation of the company." Colonel Shepherd was formerly a citizen of Chicago.

LOCOMOTIVE STATISTICS.

Burlington & Missouri River.

Mr. George Chalender, Master Mechanic of the company, makes the following report for the month of January, 1871:

Miles run by passenger trains	40,192
" " freight "	52,022
" " miscellaneous "	17,124
Total number of miles run	109,338

The average cost per mile was:

For repairs	6.26 cts.
For oil, waste and tallow	.78 "
For fuel	8.87 "
Total cost per mile run	15.91 cts.
For engineers, firemen and wipers	7.93 "

The average number of miles run was:

To one ton of coal	38.19
" pint of oil	14.50

Coal is charged at $3.50 per ton. Forty-nine locomotives made mileage during the month, and four were in shop.

Pittsburgh, Fort Wayne & Chicago.

Mr. S. M. Cummings, Master Mechanic of the Eastern Division, makes the following report for the division for the month of January, 1871:

The number of miles run was, on

Passenger trains	78,333
Freight trains	246,673
Wood trains	1,5 0
Ballast trains	8,729
Total	335,233

The cost per mile run was for

Repairs	4.64 cts.
Fuel	6.07 "
Stores	1.09 "
Other accounts not included in above	.94 "
Total cost per mile run	12.74 cts.
Engineers, firemen and wipers	6.92 "

Average number of miles run to

Pint of oil	13.96
Ton of coal	41.49

One hundred and forty-four locomotives are employed on the division; six of these made no mileage during the month, six were in shop part of the month, two are worn out, and new engines building to take their places, and five engines are in shop for repairs.

Illinois Central.

The annual report of the company for 1870 includes the following comparative statement of the performance of locomotives for the last ten years:

Years	Total miles.	Cost of oil, waste and tallow per mile	Cost of wood, coal and coke per mile	Cost of wages of engineers and firemen per mile	Cost of repairs per mile	Cost of cleaning engines per mile	Tr'l cost p'r mile.	Average miles to a pint of oil	Average miles to a cord of wood	Average miles to a ton of coal
1861	2,458,629	.72	7.49	3.84	6.29	.57	18.92	14.44	39.73	37.80
1862	2,591,192	.67	6.10	3.85	6.23	.57	17 42	15.51	43.83	37 00
1863	3,010,697	.88	9.05	3.93	7.69	.73	22.28	15.05	37.64	35.22
1864	3,38 ,850	1 35	11.87	5.56	13.97	1.05	33.5	12.67	37.06	32.16
1865	3,5 7,466	1.99	10.45	5.65	17.89	1.24	37.44	12 60	43.35	32 80
1866	3,603,862	1.30	8 42	5.78	16.01	1.16	32.67	14.28	68.58	34 04
1867	3,765,216	.71	7.13	6 18	14.45	1.15	29.62	14.76	....	34.98
1868	4,593,446	.72	6.88	6.11	12.72	1 14	27.57	14.89	46.01	37.38
1869	5,514,303	.78	6.56	5 88	11.27	1.05	25.49	14.97	....	37.04
1870	5,387,606	.78	6.83	5.95	10.45	1.14	25.15	13.52	....	35.07

The yearly averages of the number of cars hauled vary from 11.40 to 12.82, the average for the ten years being 12.34—rather a remarkable lack of variation. It will be seen from the table that the item of "repairs" has decreased each year since 1865, when war prices were paid for labor. One of the most important savings in the company's operating expenses during the past year has been in the cost of locomotive and car repairs.

—At a fair in Braintree, Massachusetts, lately, a silver-plate conductor's punch was presented by Mr. L. O. Crocker, of East Braintree, who manufactures such articles, to be presented to the most popular conductor on the Old Colony Railroad. To decide the matter, visitors were permitted to vote for their favorite at the rate of a dime apiece. The result was that 1,106 votes—and dimes—were deposited for F. W. Howland, and 1,438 for conductor Olmstead, of the South Shore train, and the treasury made $254 out of the punch.

The Action of Steam in the Cylinders of Locomotives.

BY FRED J. SLADE.

[Continued from Page 604.]

Period of Compression.—With the link motion, as with all other valve motions in which a single slide valve is used to cut off the steam at an early point in the stroke, it is an inevitable result that the escape of the steam in front of the piston on its return stroke will also be cut off before the latter has reached the end of its stroke. The steam remaining at this instant between the piston and the end of the cylinder is, when the piston has completed its stroke, compressed into the space of the clearance and the steam ways, and in undergoing this change of volume opposes a continually increasing resistance to the motion of the piston, the total amount of which, with early points of cut-off, bears a considerable proportion to the total useful pressure on the other side of the piston, and of course reduces the power of the engine in just that proportion. This diminution of power is, however, not wholly at the expense of fuel consumed, as the compressed steam fills a space which would otherwise require to be filled with live steam from the boiler at the commencement of the next stroke. The effect is the same as would be produced by admitting less steam to the cylinder. Indeed, the waste room at the ends of the cylinder can, under the ordinary conditions existing in practice, be more economically filled or partially filled by compressing through a short distance steam of about the atmospheric pressure, than by taking fresh steam for the purpose. That is to say, the work absorbed in compressing the low-pressure steam, as shown by the area cut off from the indicator diagram by the rounded corner thus produced, will be less than the work which the amount of live steam required to fill the same space under the same pressure would have been capable of doing if admitted while the clearance space was filled and expanded in the usual manner. The compression of the steam in front of the piston, as it approaches the end of its stroke, serves a purpose which is of considerable importance for the smooth working of the engine, in absorbing the momentum of the reciprocating parts when brought to rest at that moment. The propriety of employing this "cushion" of steam when it can be avoided, as well as the amount of it which should be allowed, are questions upon which engineers hold diverse opinions, and with those forms of valve gear which do not necessitate compression, it is frequently dispensed with altogether, with the idea that its presence is injurious, rather than beneficial. The value of compression will, of course, depend on the manner in which the steam is worked in the cylinder, the weight of the reciprocating parts, and the speed of working, and therefore will not be the same for all engines. But these data being given, it is then perfectly possible to find the exact pressure coming on the crank pin at the end of the stroke, and thus to determine whether a cushion of steam in front of the piston would serve a useful purpose in reducing, and finally reversing the direction of that pressure, before the admission of the full pressure of steam, and thus avoiding any tendency to thumping and heating.

If we neglect the effect of the varying inclination of the connecting rod in producing the unequal velocity of the piston at the opposite ends of the stroke, and take simply the motion of the crank pin measured in the direction of the centre line of the engine, we can find a very simple rule for determining just how much pressure per square inch of the piston is required to start the reciprocating parts into motion, or to bring them to rest again, as the case may be. The quantity of work stored up in the reciprocating parts at any instant is proportional to the square of their velocity, and the difference of the squares of their velocities at any two points will represent the amount of work imparted to or taken from them in passing through that interval. The pressure exerted either in the direction of the motion of the piston, or the opposite, according as the parts are being stopped or started into motion, will, therefore, be proportionate to the difference of the squares of their velocities at any two points, divided by the distance moved through in passing between them, measured on the centre line, since the quantity of work imparted or abstracted is the product of the pressure by the distance through which it is exerted. Now if we let

S = mean speed of piston in feet per second,
R = revolutions of engine per minute,
L = length of crank in feet,
W = weight of reciprocating parts,
a and a^1, two consecutive angles of the crank differing from each other by but an infinitely small angle,
A = area of piston in square inches,
P = pressure exerted by the inertia of the parts,

then $1.5708\ S \sin a$ = forward velocity of reciprocating parts in feet per second, and we have

$$\frac{(1.5708\ S \sin a)^2 - (1.5708\ S \sin a^1)^2}{L \text{ ver sin } a - L \text{ ver sin } a^2}$$

as the difference of the squares of the velocities of the parts at two consecutive points divided by the distance passed through between them. Now we know from the laws of falling bodies that the force of gravity, or a pressure equal to the weight of a body, will impart to it a velocity of 32.2 ft. per second in moving through 16.1 ft., and hence we have this proportion:

$$\frac{(1.5708\ S \sin a)^2 - (1.5708\ S \sin a^1)^2}{L \text{ ver sin } a - L \text{ ver sin } a^1} : \frac{(32.2)^2}{16.1} :: P : W,$$

or,

$$\frac{(1.5708\ S \sin a)^2 - (1.5708\ S \sin a^1)^2}{L \text{ ver sin } a - L \text{ ver sin } a^1} W = \frac{(32.2)^2}{16.1} P;$$

and collecting the numerical and known quantities in one term of the equation, we have

$$\frac{.0383\ S^2 W}{L} \times \frac{\sin^2 a - \sin^2 a^1}{\text{ver sin } a - \text{ver sin } a^1} = P;$$

but the second fraction is equal to 2 cos a*, and hence we have,

$$P = \frac{.0766\ S^2 W}{L} \cos a.$$

Cos a being a factor of this quantity shows us that the value of P will vary in the direct ratio of the distance of the crank pin from the center of the stroke measured on the center line. At either end of the stroke cos a — 1 or the pressure absorbed or given out by the inertia of the reciprocating parts, would be $.0766 \frac{S^2 W}{L}$, while at the center of the stroke cos a — 0, and no pressure would be exerted, the parts moving for the instant with an uniform velocity. To render this formula a little more ready of application, we may express the speed of piston in terms of the number of revolutions per minute instead of in feet per second. For this purpose we have, $S = \frac{R\ L}{15}$, and substituting this above, we have $P = .00034\ R^2\ L\ W$. For the pressure per square inch of piston equivalent to this, we of course have:

$$\frac{P}{A} = p = \frac{.00034\ R^2\ L\ W}{A}.$$

With this formula, therefore, we can easily draw on an indicator diagram a curve which shall represent the pressure on the crank pin for each point of the stroke, by adding the pressure given by the formula for each point to that shown by the diagram during the last half of the stroke, and substracting the same quantities during the first half.

To illustrate by an example:

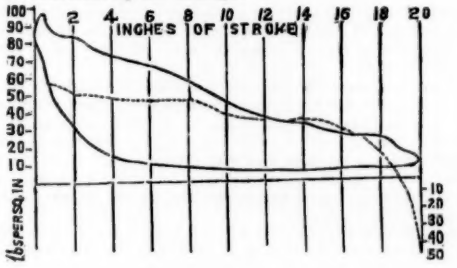
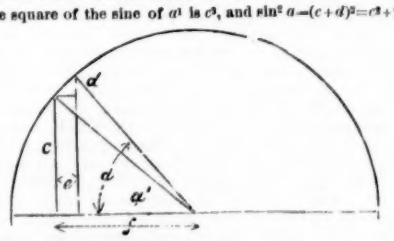


Fig. 12.

The diagram, Fig. 12, shows the pressure existing in the cylinder of a locomotive in which the weight of the reciprocating parts was 450 lbs.; area of piston, 254 sq. in.; length of crank, 10 in., and the speed of working, 250 revolutions per minute. The formula gives us, on substituting these values, 31.3 lbs. as the pressure per square inch of piston equal to the force exerted by the reciprocating parts *at each end* of the stroke. The pressure for any other point being proportional to the distance of that point from the middle of the stroke is readily found, and it only remains to determine the effective pressure of steam existing on the piston, and to add or subtract the quantities formed from the corresponding values of the latter. Supposing the diagrams obtained from the opposite ends of the cylinder to be identical, we have to subtract from the steam pressure shown at each point, measured from the atmospheric line, the exhaust pressure at each corresponding point of the stroke, reckoned from the other end of the diagram, the difference being the effective pressure of the steam. Correcting these pressures by the amount of the momentum of the reciprocating parts in the manner just stated, we obtain a series of pressures represented by the dotted curve as the force coming on the crank pin. In the example chosen the pressure in the cylinder immediately after the commencement of the stroke is 98 lbs., while that coming on the crank pin is but equal to what would be exerted by 61 lbs. per square inch. This pressure decreases slowly as the piston advances, and reaches 30 lbs. at about 4-5ths of the stroke. It then falls rapidly until it reaches the atmospheric line, which it crosses at about 1½ in. before the end of the stroke, the pressure on the crank pin now coming in the opposite direction, and reaching, finally, a point corresponding to a pressure in the reverse direction of 48 lbs. per square inch. It is obvious that in respect to ease of working of the journals this curve is much more favorable than the one representing the steam pressure, since the excessive pressure at the commencement, when it is least effective, is reduced, and, consequently, the friction which it would produce also, while the feebler pressure at the end is augmented from the store contained in the moving parts, until the crank pin approaches the center line, when the pressure is gradually removed by the "cushion," and finally exerted in the opposite direction, preparatory to the next stroke, thus preventing shock when the steam comes upon the piston, as the connecting rod will have been brought easily to a bearing against the side of the crank pin on which it is now to act, and any slack taken quietly up. The dotted curve, therefore, shows that in quick-running, expansive engines the pressures on the crank pins are not so irregular as might be supposed from the appearance of the indicator diagram, the reciprocating parts acting, in fact, similarly to a fly-wheel in equalizing the pressures exerted at different parts of the stroke. As the momentum of the parts increases as the square of the speed, it follows that the value of p will decrease rapidly as the speed diminishes. At high speeds the engine is always worked in the shortest notch, and the compression is, accordingly, a maximum, as it should be. For a goods engine, on the other hand, working at, say, 100 revolutions per minute, the value of p would be but 5½ lbs., and hence, if the exhaust is well conducted, but little compression would be desirable. The period of admission, however, in such cases is usually longer than in fast-working engines, and the amount of compression correspondingly less.—*Engineering.*

[To be continued.]

* The square of the sine of a^1 is c^2, and $\sin^2 a = (c+d)^2 = c^2 + 2dc + d^2$, hence $\sin^2 a - \sin^2 a^1 = 2dc + d^2$.



Also ver sin a — ver sin a^1 is seen from the figure to be e; we have, therefore,

$$\frac{\sin^2 a - \sin^2 a^1}{\text{ver sin } a - \text{ver sin } a^1} = \frac{2dc + d^2}{e} = (2c+d)\frac{d}{e}.$$

But d and e, and f and c being like sides of similar triangles, we may write for the above,

$$(2c+d)\frac{f}{c}, \text{ or } 2f + \frac{df}{c}.$$

But d being by supposition an infinitely small quantitity, the term $\frac{df}{c}$ becomes equal to 0, and we have the quotient $2f$, or $2 \cos a^1$ or $2 \cos a$, the difference, e, being also by supposition infinitely small.

Should Locomotive Engineers be Mechanics?

We often hear the above question asked, and we often hear arguments, *pro* and *con*, upon this subject. The one party contending that it requires no mechanical ability to run a locomotive engine, while the other as strenuously maintains that the engineer should fully understand every part of his engine, and be at least able to superintend all repairs, if not able to do the work himself.

Many members regret the absence of mechanical articles relating to locomotives, in the *Journal*, while others think the mechanical knowledge belongs to another department. And some master mechanics, commenting upon several mechanical articles that have appeared in the *Journal*, have remarked that the "engineers better let them things alone."

The purpose of this article is to give a kind of historical sketch of the causes that have brought about this conflict of opinion, and to offer some suggestions, with the hope that it will induce other pens than mine to fully write up this subject, so that the locomotive engineer may know where and how he is to be qualified to perform all the duties that pertain to his calling.

First, let us go back to the time that locomotives were first successfully introduced, and practically brought into use as a motive power for the purpose of transporting persons and property, and inquire what kind of persons were selected to run them.

Stephenson employed his most skillful mechanics to run his engines. At the first public trial to test the feasibility of locomotives as a motive power, Stephenson run one of the engines himself; and upon the same occasion the best men from the shop that had been employed constructing the engines, were selected to run them. George Stephenson was so well known as a thorough man, requiring all employed under him to fully understand and faithfully perform whatever they undertook, that for many years his men were sought after as much the best locomotive engineers that could be found.

The reason for this was not wholly on account of the mechanical ability they possessed, but the temperate and industrious habits they had acquired under their illustrious employer gave them a standing which placed them in the front rank as engineers.

After the locomotive had proved itself superior to any other power for the purpose of transportation, railroads were constructed very fast, and of course a great demand was created for locomotive engines. After a time it was found that a fireman with no practical mechanical experience, but by becoming familiar with the engine and its works, could run very well, and from that time to the present most engineers have been made from firemen. Occasionally a mechanic from the shop goes out on the road and becomes an engineer. It is not possible to make all mechanics or firemen *good* engineers, each must exhibit and practically demonstrate his skill, before he can be pronounced by any authority a competent engineer. There is more about the business of running a locomotive than to be able to construct, adjust, and repair all its parts. And perhaps this other qualification alluded to is the most important of all, at any rate no man can become a good engineer unless he is able to regulate the speed of the engine, properly attend to the pumps, carry an even pressure of steam on his boiler, start and stop his train without breaking couplings, or injuring persons and property, always keeping an eye to see that the way is clear, and all switches right. Also to always to take the safe side in arriving at meeting and stopping places.

All these qualifications can be acquired without any particular mechanical knowledge of the parts of the engine. But there are many other valuable qualifications for an engineer, which cannot be acquired without some mechanical experience.

It is a very common saying that as long as everything goes right anobody can run; this may be partially true, if no regard is had to time or safety. But there are many emergencies, in the experience of a locomotive engineer that requires the best talent and practical knowledge of the best men in the business, to avoid serious if not fatal disaster to his train and all on board.

If an engineer was to be selected to take an engine to some distant part of the country where there was no facilities for repairs, except such as he was able to do in person, would it be good judgment to employ an engineer that knew nothing about mechanical work or his engine except to run her? The fireman that is most anxious to be promoted, would not employ such a man to go out of reach of the shop.

Now there are hundreds of accidents and delays to trains every year that could have been avoided if an

experienced and thoroughly competent engineer had been employed. How often does it happen that some slight breakage of the engine detains not only the train it is drawing, but other trains for hours, and if the truth was known the delay could be traced to a want of knowledge by the engineer.

The real truth of the cause of many delays and accidents is rarely known to only a few; the master mechanic does not wish to have it known that he employs incompetent men, and it is for the interest of the railroad companies to sustain their employes in cases of claims for damages. Then I fear that there is another cause that is most *potent* in allowing incompetent engineers to be employed. They can be hired cheaper, but in reality they are much the dearest kind of men to employ.

I do not wish to be understood as classing all engineers that are not mechanics as incompetent; on the contrary, I believe that there are just as good engineers that are not practical mechanics; in the sense that this term is generally used, they have never served an apprenticeship to any particular trade, but they have become familiar with every part of their engine, and can do all ordinary repairs. I may say here that I do not believe that a man ever learned to be a mechanic; if he was not born one, it will be useless for him to aspire to that position.

A man may learn to perform certain mechanical labor. So a machine can be made to perform the same labor,and yet possess no intelligence. But the man that designed the machine possessed both intelligence and mechanical knowledge.

What is wanted most in a locomotive engineer is the faculty of adopting the right means instantly, to overcome all obstacles that may arise in the performance of his duty. If his engine breaks down on the road, he must know just what to do to repair it up, if possible. In short, he must know just the right remedy to apply in all cases of trouble; and he will be much more profitable to the company if he fully understands all the *ills* his engine is liable to encounter.

The reader will infer that I am in favor of having mechanics for engineers, but in coming to that conclusion, I hope that they will remember that any natural mechanic can quickly learn to apply his talent to any ordinary kind of mechanical business. And a fireman is a dull scholar, with no mechanical ability, if he does not master the main points about a locomotive, by being employed as fireman for five or six years. My belief is that the plan adopted by many railroad companies, to not allow engineers or firemen to work in the shops when their engines are laid up, is, to say the least, bad policy for the companies. The engineer or fireman might learn that about his engine while in the shop which might save more to the company than three times his wages.

Engineers, and those who expect to be engineers, my advice to you is: perfect yourselves in everything that relates to your engine, or business. The time is not far distant when the public will hold engineers to a strict accountability for all accidents and delays; and when the test is made you do not want to be found to be at fault. Educate and perfect yourself in that degree that you are master of your business under all circumstances. Then you need not fear of being held to the most rigid examination.

Young men that are looking forward with the hope of becoming engineers should use every exertion to qualify themselves to act promptly in every emergency.

The practice of sending men on the road that have had no experience, is a *fearful* experiment. And I hope to see the time that all new beginners will have to demonstrate their ability to run an engine under the eye of a skillful and thoroughly competent engineer.—*Locomotive Engineers' Journal.*

Planting Forest Trees on the Prairies.

BY H. W. S. CLEVELAND.

[Concluded from Page 614, Vol, II.]

A large part of this section of Mr. Cleveland's important article, beginning with the fourth paragraph and ending with the eleventh, containing the history of the Duke of Athol's great larch plantations, was not published in the *Western Rural*, from which the rest of the article was copied, but was furnished us by Mr. Cleveland:

Dr. Anderson, under the name of "Agricola," first called attention to the value of the larch as a timber tree in Great Britain about the year 1777. Pontey, in his "Forest Pruner," published in 1805, and Matthew, in his work on "Naval Timber" (1831), award the very highest commendation to the larch, for durability, freedom from shrinking, swelling or cracking, toughness, susceptibility of polish, and capacity to hold spikes and preserve them free from rust. From a great number of experiments recorded as tests of the different qualities of larch timber, I select the following, recorded by Sir Thomas Dick Lauder.

"The durability of the larch, when alternately exposed to water and air, was proved by an experiment made in the river Thames, at the suggestion of the Duke of Athol. Posts of equal thickness and strength, some of larch and others of oak, were driven down facing the river wall, where they were alternately covered by the tide, and left dry by its fall. This species of alternation is the most trying of all circumstances for the endurance of timber; and the oak posts decayed, and were twice renewed in the course of a very few years, whilst those which were made of larch were altogether unchanged."

The larch was first introduced into England about 1630, but was not extensively cultivated till 100 years later. In 1788, the Society of Arts offered a premium of £30 and three gold medals for planting the larch and making known its valuauble properties as timber. Public attention being thus called to it, it has been more extensively planted in Great Britain, particularly during the present century, than any other tree, not even excepting the oak.

But the planting operations of the Dukes of Athol so far exceed any other works of the kind of which we have any record, and furnish so admirable an example of what may be done to contribute to a nations's wealth by giving an almost indescribable value to lands intrinsically worthless, that I have been tempted to prepare the following condensed account from Loudon's Arboretum:

The estates of the Duke of Athol are in the North of Scotland, in Lat. 57 N. Between 1740 and 1750 the Duke began making plantations of the larch in various situations, for the purpose of testing its value, the tree being then new in Scotland. Before he died, in 1764, he was satisfied of the superiority of the larch as a timber tree, over the other firs, even in trees less than twenty years old. His successors, continuing the execution of his plans during the remainder of the century, had planted, before 1800, nearly 3,000 acres with 1,300,000 trees. Observing with admiration the luxurious growth of the larch in all situations, the Duke then determined on pushing the plantations even to the summits of the highest hills, and he went on planting till he had covered 1,600 more acres, situated from nine to twelve hundred feet above the level of the sea, its soil presenting the most barren aspect, being strewn thickly with fragments of stone on which vegetation of any kind scarcely existed.

"To endeavor to grow timber," writes the Duke, "among rocks such as I have described, would have appeared to a stranger extreme folly, and money thrown away, but I had, for more than twenty-five years, so watched and admired the hardihood and strong vegetative powers of the larch in many situations as barren and rugged as this, that I was quite satisfied of a successful result."

The planting was continued until 1826, at which time more than 10,000 English acres and more than fourteen million trees had been planted. It was estimated of 6,500 acres on which the trees had been thinned to about 400 to the acre, that their value at 72 years from the time of planting, at one-half the price then paid at the ship yards was £1,000 per acre, or £6,500,000, equal $32,000,000.

In my own experience, I have found no tree which adapts itself so readily to every kind of soil as the European larch. It seems to thrive equally well on rich soils in a high condition of culture, on sandy hills, and on rocky or gravelly ridges, affording only a scanty growth of grass. Experience has proved, however, that a dry soil is essential to the growth of the best and most desirable timber. I have never known it suffer from disease or the attack of insects, and the strength and elasticity of its wood enable it to bear with impunity the storms which make wreck of the pines and hemlocks.

I have recently received from a friend in New Jersey, near Philadelphia, the following statement, in reply to a request of mine that he would send me the dimensions of some larch and spruce trees which I planted in 1845 (twenty-five years ago), on a sandy hill, so poor as not to be worth cultivating:

"The largest larch is 35 feet high, measures 16 inches in diameter at the butt. and from 10 to 12 inches sixteen feet up the trunk, the branches growing to the ground; the other larches are from 25 to 28 feet high, and 10 or 12 inches in diameter at the butt. The largest Norway spruce is about 26 feet high, measures 10 inches in diameter at the butt. The others 17 to 25 feet high, and 7 to 9 inches in diameter; *but all of them* taper more rapidly than the larches."

I should not venture to commend the larch for Western culture on the strength of my own experience on the Atlantic coast, or that of others on European soils, but fortunately that experience has been confirmed by that of numerous planters in various parts of Illinois. The names of Kennicott, Edwards, Dunlap, Scofield, Douglas, and others will suggest themselves to those who have watched the efforts they have been making for many years with a wise foresight of the future wants of the country, all of whom will confirm the truth that my statements apply equally here.

I trust the evidence I have adduced, is sufficient to establish the claim of the larch to a primary position as an experimental tree for plantations on the great Western prairies.

The question naturally arises, When and by whom are these plantations to be made? The United States Government is obviously the party most largely interested, being the owner of nearly the whole of the territory in question, and the lands being at present almost valueless for want of timber, yet susceptible of attaining an enormous value within the period of twenty or thirty years, by a judici us system of forest planting. But if the time required to secure action upon the subject by the government is to be added to that which is needed for the growth of the trees, the period at which we might hopefully look for available results becomes too remote for American vision, which does not readily distinguish distant profits. The work should be undertaken by a company with means sufficient to insure its thorough, extensive, and systematic performance. The organization of such a company is a scheme well deserving the attention of capitalists; but as a measure of policy directly affecting their own interests, it commends itself with especial force to the Pacific Railroad Company, which, next to the United States Government, is more largely interested than any other company or individual can be, in developing the re ources of the country. An expenditure of thousands *now*, will save the outlay of millions in the future, in the mere necessities of railroad construction; and when this is added to the fact that the settlement of the region through which the road extends is almost literally dependent upon its being supplied with timber, while the interests of the road demand such settlement, as manifestly the most direct means of increasing the commerce on which they are dependent, its expediency is so palpable, that it would seem almost suicidal to neglect it. At every available position along the line of the road, a nursery should be at once established, from which forest planting should be extended, with an annually increasing radius.

If nurseries are undertaken with a view to forest culture, the cost in time and labor will render it better economy to import the trees than to attempt to raise them from the seed. Seedling larch trees of one year's growth can be imported and delivered in Chicago for $5 per 1,000; probably less if large quantities were wanted. If set in nursery rows, the plants being one foot apart, and three feet between the rows, to allow room for culture with a horse-hoe, an acre would contain about 14,500 plants. From year to year the alternate plants, and after a few years the alternate rows, should be transplanted, till an average of 400 trees to an acre was attained, when the original occupants of the single acre would cover about forty-three acres. In fifteen years from the time of planting, every tree would furnish at least one sleeper. Supposing every alternate tree to be then cut, we should have 7,250 sleepers. Five years later, every remaining tree would furnish two sleepers (14,500), making in all 21,750 sleepers.

The following is an estimate of the cost.

Original cost of 14,500 plants at $5 per 1,000	$ 72 50
Culture for six years (after which they may be left to themselves) say $100 per annum	600 00
	$672 50
Interest on the above for 20 years at ten per cent.	1,345 00
Total cost of 21,750 sleepers	$2,017 50

The sleepers, therefore, will have cost less than ten cents each. At present rate of fifty cents each the same number would cost $10,875, leaving a profit of $8,857.50. In the above statement, nothing has been allowed for value of crops which might be grown between the rows; no account has been made of the value of the tops of the trees, which would be worth nearly as much for fencing as the butts for sleepers, and finally the interest on the whole cost is estimated for twenty years, while one-third of the sleepers would have been furnished in fifteen. I have endeavored in this estimate, as in the previous ones, to furnish the simplest and most easily verified data, the object being to suggest to the reader, rather than attempt to indicate in detail, the immense value of such an investment, if conducted on a scale, commensurate with its importance.

Railroad Discipline.

After legislators and newspaper censors have exhausted their ingenuity in devising laws for the prevention of railroad accidents, we hope that some brilliant genius will make the discovery that it is not so much new rules that are needed for the improvement of railroad management, as a more perfect system and more thorough discipline among those employed by the companies to carry existing rules into effect. Discipline among the employes in every branch of railroad service is indispensably prerequisite to the harmonious working of any system of management, whether simple or complicated, and it is only when each man knows his duty and does it with promptness and precision that the danger attending the running of railroad trains can be reduced below the present average. The testimony elicited before the coroner's jury and the Legislative Investigating Committee, relative to the causes of the New Hamburg disaster, show that to a want of discipline among the employes on the two trains the series of horrors which followed the breaking of the oil car axle are in part, if not wholly, attributable. For example, the rules laid down by the Superintendent directed that the long freight train should have three brakemen, one in front, one in the middle and one at the rear end; but the night was cold, and instead of remaining at his post, the middle brakeman went forward into the caboose and remained there with the head brakeman, who was also off his post. Clearly, it was the duty of the conductor, who was chief employe upon the train, to have seen that these men remained in their proper positions, ready to perform at any moment their proper duties; and the laxity of discipline which is thus shown would seem to indicate that, in the opinion of the company's servants, the rules of the superintendent are of little or no consequence. Again, the rules of the road require that every train, whether freight or passenger, have a bell-cord, but this rule was also violated, and, had the middle breaksman been at his post, and discovered that one of the axles had broken, he could not have communicated the fact to the engineer without climbing over the intervening cars to the locomotive. We merely allude to these circumstances as showing how great is the danger attending the infraction of a company's rules by irresponsible employes, and how necessary it is to the safety of the traveling public that these rules should, in every instance, be obeyed promtly and without question.

Considering the mischief which can be wrought by one incompetent, inefficient, or careless employe, it is a mistaken economy on the part of a railroad company to employ inferior men because their services can be had for less wages than men of intelligence and energy can command in other and pleasanter occupations. Good men, at whatever cost, must be employed to fill the minor positions on our railroads, if the safety of the traveling public is a consideration, and every infraction or violation of an established rule must be punished by the prompt suspension or dismissal of the offender. It is only upon those roads which are badly or imperfectly managed that travel is attended with any extraordinary degree of danger; and when the public shall learn to discriminate against such roads, the evils resulting from a want of better and more thorough discipline will promptly correct themselves.—*New York Bulletin.*